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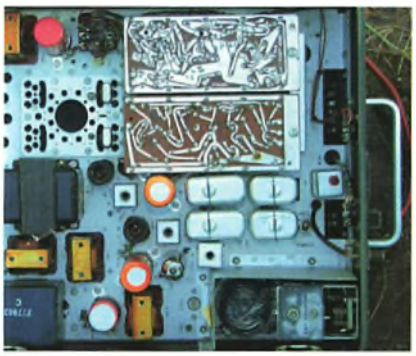

Valve & Vintage
A look back to Pye equipment

Early Transistors
Invention and development

Antenna Couplers
Their theory and use

AN IN-DEPTH REVIEW OF THIS SOLID HANDHELD

WE TAKE A LOOK AT THE

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Elecraft is the undisputed leading performer in analogue transceiver design. This is confirmed both from www.sherweng.com and the many DXers and DXpeditions that use this equipment. Even the little KX3 will outperform almost anything else! But there is also another hidden advantage. It holds its price far better than any other range I know of. Compare the used prices of Elecraft with other mainline radios and you will soon see what a great investment it is. Ten year old K3s are still commanding good money. And talking about part exchange, we are more than happy to quote for your unwanted radio equipment. Call Paul or Glyn on 01702 206835.

Peter Waters G3OJV

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Elecraft K3S 100W HF - 6m Transceiver

- Ultra low-noise synthesizer for strong-signal receive handling and transmit signal purity
- USB port remote control and line-level audio, eliminating the need for a PC sound card
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- Lower-loss ATU option with true bypass relay (KAT3A)
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- Coverage of the 630-meter band (–470 kHz), and lower1

Superhet / SDR Architecture

The K3S delivers the best of both worlds: a hybrid of software-defined radio (SDR) technology and our proven, high-dynamic range superhet receive architecture. The optional KRX3 high-performance, fully independent sub-receiver offers true diversity operation to reduce fading. 32-bit DSP provides stereo effects, NR, EQ, notch, and built-in PSK31/CW/RTTY decode/encode.

The K3S offers great value for money. Still the best analogue transceiver currently in production, it has great versatilty. Its light weight makes it easy to carry on DXpeditions. Its performance is legendary and beats any comparable transceiver, regardless of cost. You are protected against obsolescence by virtue of regular firmware updates and replacement modules. And you only pay for what you need! A wide range of options allow you to add a wide range of features to.

Elecraft K3S Transceivers

K3S/100-K	100W Transceiver Kit	£2699.95
K3S/10-K	10W Transceiver Kit	£2199.95
K3S/100-F	100W Transceiver Ready Built	£2849.95
K3S/10-F	10W Yransceiver Ready Built	£2329.95

Accessories

KPA3A	100W PA for K3 10W Models	£549.95
KAT3A	Wide Range Auto ATU	£449.95
KFL3	8-Pole Roofing gi;ters	from: £169.95
KRX3A	Second Independent Receiver	£849.95
K144XV	2m Transcerter 8W	£449.95
KDVR3	Voice Recorder	£199.95

Top Choice for DX & DXpeditions
Elecraft Value for Money

Sherwood Engineering are the leading test house for ham radio transceiver performance. Their ratings are a great indicator for planning your purchase. You can check for yourself by going to www.sherweng.com. Here are the top contenders - half of them Elecraft!

1st	FlexRadio Transceiver Flex-6700	£6,899.00
2nd	Icom IC-R8600 (Receiver only)	£2,499.00
3rd	**Elecraft Transceiver K3S**	**£2,849.00**
4th	**Elecraft Transceiver K3S (2nd)**	**£2,849.00**
5th	**Elecraft K3 (upgrade)**	**Discontinued**
6th	Icom Transceiver IC-7851	£9,999.00
7th	Hilberling PT-8000A	£12,000+
8th	**Elecraft KX3**	**£1,149.00**

Elecraft KX3 160 - 6m, 15W

There is something very special about the KX3. It out-performs any similar transceiver and almost all of the base stations. You can run it at 100mW or increase to any power up to 15W (a bit less above 20m). You can add 2m or 4m, Add a narrow roofing filter or auto ATU. No other rig can match it.

Kit: £1099 Built: £1149

- KXAT3 ..... ATU £239.95
- KXFL3 ..... Filter £189.95
- KXBC3 ..... Timer £99.95
- KXPD3 ..... Key £159.95
- DC Lead £11.95
- 2m Transvert £309.95
- 4m Transvert £309.95
- MH3 ..... Mic £79.95

KXPA100-F0
100W PA for:
- KX3 • KX2
- FT-817

- FT-817/818 option £11.95

Kit: £899.95 Built: £949.95

KPA500 600W HF-6m Amplifier
Matches Any HF Transceiver

- 600W Solid State FET
- Same Size as K3D
- Built-in AC Power Supply
- Low noise analogue AC Supply
- Instant Operation
- RF sensed Band Change
- Ultra High Speed QSK
- No switching noise
- Able to receive band data
- 6 Speed temp. Sensing fan
- VSWR Protected

Kit £2449.95 Built £2699.95

The KPA500 easily delivers 600W output and can be driven by any HF transceiver that can provide around 30W of drive power. Instant operation from switch on means that DX is not missed. The large bar graph give true pep indication and the small foot print will enable it to fit onto almost any desk.

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Have a play with our demo radios and have a free coffee while you are here! The showroom is an Aladdin's cave full of goodies - and our knowledgable staff are here to advise you.

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New From Ham Radio Store!

KX-33 For KX2, KX3, FT-817 and FT-818

A Power Supply in your Pocket!

This power supply is ideal for taking around. It fits into your pocket and plugs directly into Elecraft KX2 and KX3. Adaptor leads for FT-817/FT-818 and K3/10.

- 4 Amps
- 14V DC out
- 110 / 230V Auto
- Very Low Noise

£69.95

The Alex Loop MkII Portable 40-10m

Low Noise, Low Profile

A loop antenna is a very efficient antenna which also exhibits narrow bandwidth for optimum receive conditions and high noise rejection. Measuring around 1m diameter, it will handle up to 25W of power and now features gold plated connectors for extremely low loss

£449.95

The Alex folds down into this very small package. Assembly takes no more than a couple of minutes. Tuning is continuous and smooth. Typical VSWR is 1.5:1 or less and no ATU is needed. It's the perfect travel companion.

IC-7300 HF - 4m Transceiver

Almost every ham operator knows somebody who owns an IC-7300. That in itself is a great recommendation. It is the most successful radio for many years. Primarily because it is based on SDR that offers so many advantages and results in such a great receiver. And the added bonus with the IC-7300 is the 4m coverage. It's a great all in one station with lovely colour screen full of information. The internal ATU copes well with most antennas and the touch screen makes operations much easier to navigate the various functions.

£1199

The New IC-R8600 Receiver

A Great Receiver at a Great Price

£2499

- 10kHz - 3GHz SDR wide band performance
- Absolute S-Meter Measurements
- Supr FPGA for ultimate processing
- Great dynamic range for modern band conditions
- 2000 memories with full scanning
- Spectrum scope with waterfall
- SD card slot and I/Q output

Icom AD-55NS Power Supply

DIAMOND Yagi Antennas

A great range of 6m, 2m and 70cms light weight Yagi antennas rated at 100W with Japanese engineering

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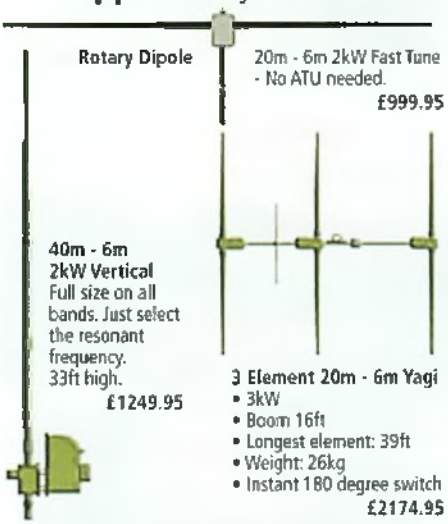
A144S5R.....2m 5 Element 9.1dB 1m boom £39.95
A-430S10R ..70cm 10El, 13.1dB 1.19m boom.....£52.95
A-430S15R ..70cm 15 El. 14.8dB 2.24m boom.....£62.95
A-1430S7 .....Dual 2m/70cm 7/9dBi 1.25m boom..£129.95

SteppIR 'Always Resonant'



Rotary Dipole

20m - 6m 2kW Fast Tune - No ATU needed.

£999.95

40m - 6m 2kW Vertical

Full size on all bands. Just select the resonant frequency. 33ft high.

£1249.95

3 Element 20m - 6m Yagi

- 3kW
- Boom 16ft
- Longest element: 39ft
- Weight: 26kg
- Instant 180 degree switch

£2174.95

All antennas include the remote controller box

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Purchase a Pro-7 Headset and get a FREE adaptor lead for your radio

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Heil Headsets

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Pro-Set-Elite-IC ...As above with lead for Icom £197.95
PMS-6.....Micro headset - single ear * £85.95
PMD-6.....Micro headset dua ear * £99.95

* These headsets need adaptor leads £25.95 each
Please quote radio model

CUSHCRAFT MA6B

6-Band 1.5kW Compact Yagi

- 20m - 6m
- 1.5kW
- 2 Els. per band
- Boom 2.2m
- Turn Radius 2,9m
- Gain 3 - 5dB
- F/B ratio up to 20dB
- Weight 11.8kg

Hustler HF Verticals

4BTV

40m - 10m 4 Band vertical that will handle full legal power and can be ground mounted Height is 6.52m. £209.95

5BTV

The ever popular 5-band model that covers 80m to 10m. This is a great backyard antenna that can be ground mounted. The height is 7.64m £269.95

6BTV

This antenna is identical to the 5BTV above but has the 30m band added. Again it handles full legal power and stands 7.3m high. £289.95

All antennas are rated at 1kW.

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20 Amp micro PSU variable voltage switchmode power supply, excellent value.

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45 Amp variable voltage switched mode power supply with 'noise shift' feature.

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Power-Max-65

65 amp variable voltage heavy duty switched mode power supply with 'noise shift' feature.

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Yaesu FT-450D-WB

Wide-BandVersion. Please check if "WB" version is legal in your country

£568.95

The FT-450D is a compact yet superb HF/50 MHz radio with state-of-the-art IF DSP technology configured to provide World Class performance in an easy to operate package. Suitable for all applications; beginners, casual operators, enthusiasts, portable/field users and emergency service providers. Exclusive 3-Year Warranty

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AOR of Japan

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AR-DV-10
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At last, a scanner that will allow you to listen to digital signals. It automatically detects the mode. Of course it also works on AM and FM as well. A total communications monitor in the palm of your hand.

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Decode: D-STAR, P25, NXDN, dPMR digital & AM/FM/WFM modes

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- And more!

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All mode receiver with a wide range coverage of 530kHz-3GHz and enhanced, brighter display. Extend the capabilities of the MkIII by expanding the memory to 4,000 channels with the memory card slot.

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STAR BUY!

AR-8600 MkII

The AR-8600 MkII is a high performance all-mode communications receiver that covers the frequency range from 100kHz to 3GHz. As such it covers the complete radio spectrum. DC lead included.

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LA-400
Indoor Loop Antenna

This loop antenna covers the range 500kHz to 500MHz and can be used with any receiver. It offers low noise reception and is directional. This is a serious accessory for the AR-8600 MkII. Includes connecting lead and AC power supply.

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Portable all mode Communications Receiver

Tecsun PL-680

This NEW fully featured portable world band radio, with SSB reception, keeps you in with the action from Long Wave, Shortwave to VHF Airband!

- LW MW SW (1.7-30MHz) FM Broadcast
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- AM FM SSB
- Battery Operation (4 x AA)
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Black Box
Cockpit Monitor

This device allows you to listen to flight deck communications without any need for tuning. Just switch on and listen. Requires PP3. Includes earpiece.

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New!

AirSpy HF +

PC not included

The New SDR Receiver
HF-VHF 9kHz-260MHz

This is a new high performance receiver that employs the latest SDR technology to harness the power of your PC to bring you a receiver performance that a few years ago was impossible at almost any price. The AirSpy connects to your USB port and will resolve all the popular modes of transmission and give you a live panoramic display of signal activity.

- Works with Windows • LINUX • OSX

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FlexRadio SDR Transceivers

Flex-6400 HF - 6m 100W

£1999.00

HF - 6m 100W Transceiver. This radio is designed to work in conjunction with your PC or touch Pad. It is just as much at home with either Windows or Mac based systems.

SDR DEMO CENTRE

Here in Portsmouth we have our own SDR demo centre that allows you to hear SDR in a low noise situation whilst enjoying a coffee!

Flex-6400M HF - 6m 100W

The Flex-6400M adds a touch screen allowing the radio to be operated entirely on its own or with a PC. Again, Windows or Mac systems are catered for.

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All your radio needs under one roof!

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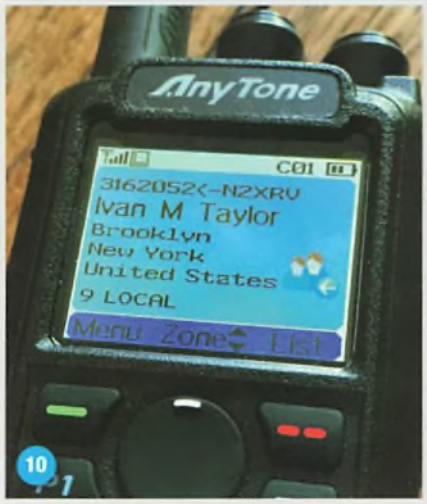

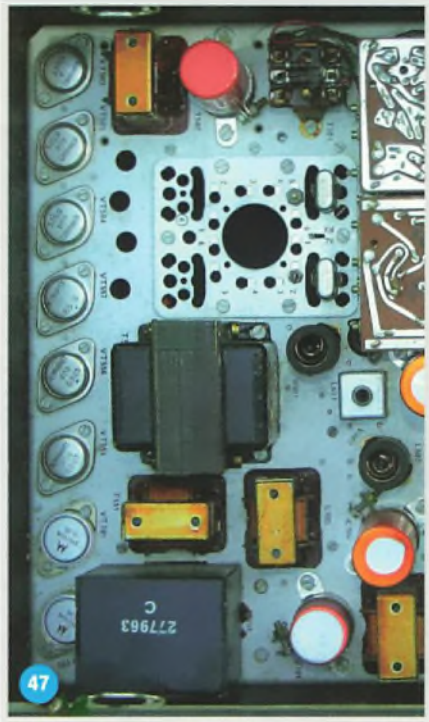

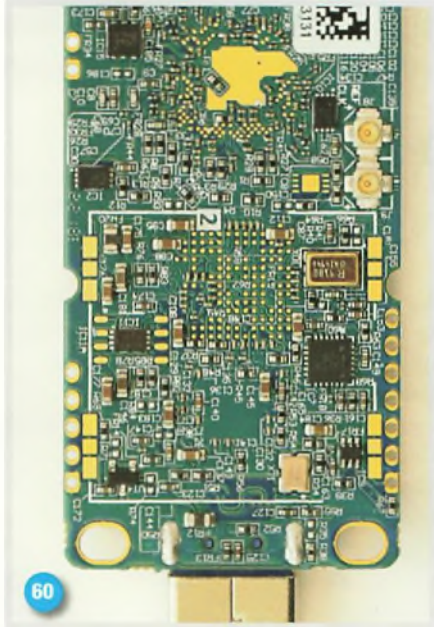

Keylines

Don introduces some of this month's articles and reports on the passing of an old friend of PW.

This issue appears mid-September, by which time schools are back, the autumn equinox is imminent – often a great time for long-haul propagation – and the new round of events, contests and DXpeditions will have started. Not that the summer was a washout in terms of radio – plenty of portable activity, some great Sporadic E conditions on the VHF bands and all that hot, dry weather, perfect for antenna work!

Antenna Couplers

There is a lot of misunderstanding about antenna tuners/couplers/what you will. Some of the theory was covered by **Vince Lear G3TKN** when he reviewed two LAMCO units in the September 2017 issue of *PW* but it's a big subject. I'm delighted, therefore, that this month we have an in-depth article on the topic by my old friend and highly experienced engineer **Peter Chadwick G3RZP**. The article has already appeared in the VMARS (Vintage and Military) magazine and the CDXC (UK DX Foundation) *Digest* but Peter retained the copyright and has kindly offered the article to *PW* to give it a wider readership, for which I am very grateful.

Getting Back into the Hobby

This month, along with **Lee Aldridge G4EJB's** *Starting Over* feature, we begin a complementary series by **Joe Chester MW1MWD**, relating his trials and tribulations as he returns to the air after settling in a small house in South Wales. Too often, amateur radio magazines seem to cater primarily for those with big gardens and even bigger antennas and forget that most radio amateurs are less fortunate. The tales of exotic DX and big stations can be off-putting. I'm hoping these articles will redress the balance a little – I wonder how many newcomers are put off because they don't get great results from Day 1.

Personally, I'm fortunate in that when we last moved house we could afford somewhere that had the space for a serious mast (although I doubt I would get planning permission nowadays – things were more relaxed 30+ years ago). But I recall my first attempts on the air, with 10W on 80 and 160m from a Codar AT5 transmitter into a random length of wire strung around my parents' small garden and tuned with a 19-set variometer. It was a struggle. Fortunately, we were quite well sited for VHF work and I was able to achieve reasonable success on the 2m band with a Heathkit HW-17 transceiver and, in the first place, a simple Halo antenna.

The trick is to stick at it rather than give up at the first hurdle and I believe this is the strong message from both Lee and Joe's articles. It helps if you have local support too. I grew up in Northampton where, at the time, there were four radio clubs, three of them with shacks and antennas. Two were hosted by local companies (Paignton Resistors and Timken Bearings) but all local amateurs were welcomed and as a teenager, I was encouraged and supported. (I probably wouldn't even be allowed in nowadays without a parent or guardian but that's another matter!)

While on the subject of returning to the hobby, I had a recent chat with **Chris Taylor** of Moonraker during which he told me that buyers of Network Radios, featured in these pages a couple of months back, are often finding that it encourages them to get back on the air for real. He cited a customer who had been using a Network Radio on the Zello group, found that it reignited his interest in the hobby and returned to buy a Yaesu FT-450D and accessories. This was by no means a one-off instance. Let's hope for more, apropos of which, Chris also told me that they will shortly be stocking a Network Radio that also has DMR capabilities, which sounds like another positive development.

G3BDQ SK

While we don't 'do' obituaries (sadly, they would go a long way to filling the magazine nowadays), I did want to mention the passing of **John Heys G3BDQ** at the age of 95. John was active on the bands throughout his life and was an avid antenna experimenter, writing many of his projects up for this magazine and others, as well as having two antenna books published. He never adopted computer technology but I well recall getting long typewritten missives from him when I wrote the HF column for *RadCom*.

John was first licensed in 1948 and a founder member of the Hastings Club. He was an RAF radar technician during the war, leaving him with a sound practical knowledge of radio, which he put to good use in building gear and antennas. There is an article about his life on the Hastings club website: http://herc-hastings.org.uk

Don Field
G3XTT

Practical Wireless

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Components for PW projects

In general all components used in constructing *PW* projects are available from a variety of component suppliers. Where special, or difficult to obtain, components are specified a supplier will be quoted in the article.

Photocopies & Back Issues

We can supply back issues, but we only keep them for one year. If you are looking for an article or review that you missed first time around, we can still help. If we don't have the actual issue we can always supply a photocopy or PDF file of the article. See the Book Store pages for details.

Technical Help

We regret that due to Editorial timescales, replies to technical queries cannot be given over the telephone. Any technical queries are unlikely to receive immediate attention so, if you require help with problems relating to topics covered in *PW*, please either contact the author of the article directly or write or send an email to the Editor and we'll do our best to reply as soon as we can.

Newsdesk

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West Street, Bourne, Lincs PE10 9PH
E-mail: practicalwireless@warnersgroup.co.uk

Powerpole Adapters for the Elecraft KX2 and KX3

SOTAbeams has introduced neat screw-on Powerpole adapters for the popular Elecraft KX2 and KX3 portable transceivers. The adapters make it easier to use these radios with your existing Powerpole DC systems and are ideal for field operations.

Additionally, following the successful launch of the Tactical 7000hds telescopic mast, SOTAbeams has designed some new guying hardware to complement the mast. The range consists of two guying rings and a special top insulator. They are laser cut from dark green 5mm Perspex to match the mast and for better durability.
www.sotabeams.co.uk

Lindars Radios

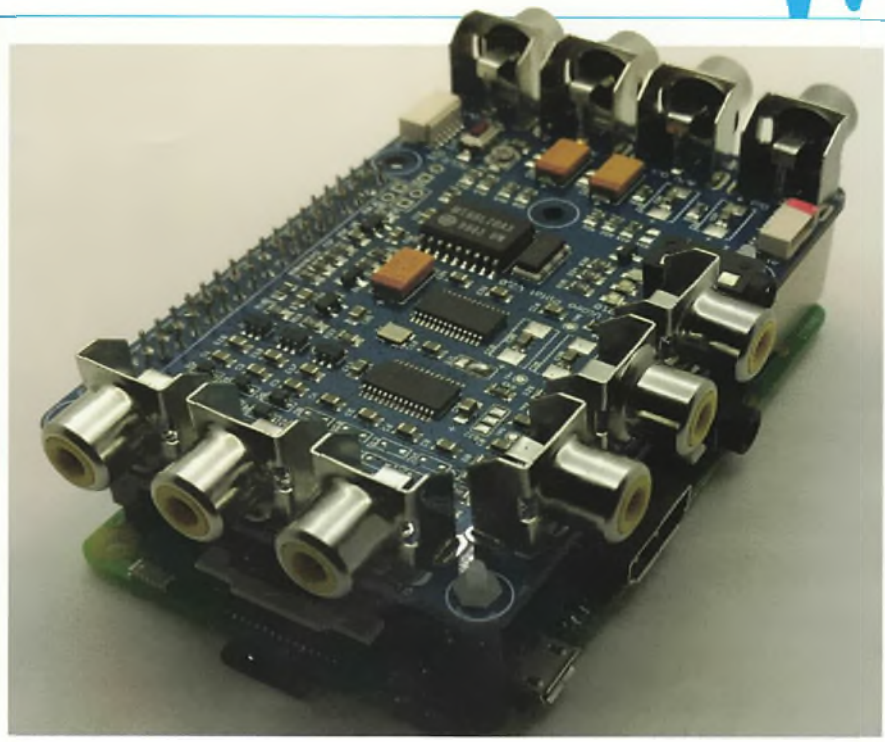
The Lindars Radios company was formed by **Justin Lindars** in 2017, a unique website was created and selling started from home. Since childhood Justin has always had a keen interest in all things radio related. His father **Martyn Lindars** was very keen on repairing and redesigning circuits and was responsible for the HAC (Heard All Continents) range of radio kits. He also wrote many articles for radio publications, including *Short Wave Magazine* and *Practical Wireless*.

Thanks to his father's keen interest in radios, Justin as a young child also became interested in the hobby. He often tested the radios once his father had repaired them. Lindars Radios have found what they believe to be a niche market, selling second-hand radio equipment and the occasional rare curiosity item. There are several companies selling brand new transceivers and receivers but Lindars Radios take pride in offering affordable second-hand equipment to fellow hobbyists and beginners.

"There is always a good feeling when older equipment is bought back to life and recirculated back into the hobby" says Justin.

Lindars Radios is now in its second year of trading. After six months at home, stock levels rose and new accommodation was sought. This consisted of a suite of four office rooms above a shop premises in Yeovil. After another nine months, stock continued to rise and customer feedback and market research indicated that a shop more accessible to the public was required. This September Lindars Radios will be opening their new shop in Yeovil. There will be a good-sized showroom with plenty of stock to tempt the hobbyists.

We at *PW* are delighted to see the Lindars name once again associated with the magazine. You'll find their ad in this issue.



HAMKit VMAC PiHat ATV Logic v2

Following the success of the original HAMKit VMAC PiHat, coupled with developer interest in the new v2, the design has been finalised and the production VMAC PiHat v2.4 PCB is in fabrication.

The new version features: Audio and Video Matrix (FMS6501), On-Screen-Display (MAX7456), Video Detect (MAX7461), DTMF Decoder (CM8870), EEPROM (24LC64), I/O ports, Audio/Video from Pi, User Status LEDs, On-board 3v3 regulator. With easy programming via Python scripts and many examples on the Wiki pages, the HAMKit VMAC PiHat can be applied to a number of typical applications and projects such as:

ATV and DATV Repeater Control Logic, ATV home, mobile or portable stations, FM Repeater Control Logic, Audio / Video matrix controller ATV/DATV, CCTV (Matrix or Auto Cycle Select), FPV (5GHz Video Camera Receivers), Video remote switching, Audio remote switching.

Further details maybe found on the hamkit website and Wiki pages:
www.hamkit.co.uk
and on their Facebook page:
www.facebook.com/hamkituk

The World's longest 50/70MHz Dual-Bander?

The new 6-4-20 antenna from InnovAntenna is a serious performer with an 11.1m computer-optimised tapered boom and ten elements on both 50MHz and 70MHz with a single feedpoint.

The 6-4-20 provides impressive performance on both bands with 14.46dBi free space gain on 70MHz and 13.41dBi free space gain on 50MHz. Placed 12m above average conductive ground, gain increases on 70MHz to over 20dBi and on 50MHz to almost 19dBi.

In addition, the 6-4-20 has been optimised for FT8 frequencies as well as the traditional operational areas of the band. SWR is reported to be flat through both bands. The new dual-bander has been in operation at OH5LK and EA5GF this summer with excellent results. The photo shows the 6-4-20 at EA5GF nested between an HF Yagi and long-boom 2m Yagi.
www.innovantennas.com

Overcoming Autism through Amateur Radio

The following report from **Andy GM6ZAK** came to us via the Worked All Britain group for wider circulation.

*I have many interests outside the world of Amateur Radio; one of which is supporting my grandson **Cameron**, now eight years of age, who suffers from autism. His condition means that we, as a family, must become part of Cameron's world as opposed to Cameron integrating into 'our' world. This is not easy to accomplish but, once achieved, is truly rewarding.*

*Cameron attends mainstream school and, with 1-2-1 support provided by a brilliant assistant, is making steady progress with his education, social and communication skills. To encourage him to communicate, we decided to introduce him to the magical world of radio. Using the PMR band, Cameron and his younger brother **Finlay** have been taught how to use handheld radios and encouraged to use them when playing in the local area. Of course, getting to use granddad's radios adds another level of excitement to the experience.*

Cameron occasionally came home from school and chatted about other students, who had brought in certificates and trophies to show the assembled classes on a Friday morning. Given the extraordinary challenges Cameron overcomes daily, I thought it would give his confidence a boost if he, too, had a certificate to show the school assembly.

In April, I contacted the WAB President and, having explained my goal, I asked for assistance. In keeping with the motto and stated aims of the organisation, the response I received went far beyond any expectations I initially held.

***John G8XTJ** very kindly agreed to my proposal and forwarded my request to the committee. **Ken G0FEX** promptly offered to sponsor Cameron's membership to WAB, something so obvious I wish I had thought of it! **Dave G4IAR** designed and produced a wonderful 'Certificate of Merit' in time for May 27th, the weekend of our next visit.*

On the stated day, I drove the short distance into the adjacent square (SJ82) and called Cameron, who answered the call. He informed me that he was in his home square (SJ92), that I was "loud and clear – top o' the shop" and unprompted he wished me a very happy birthday, which was the reason for our visit. He then went on to have a nice and unexpected chat with me, mainly about the merits of cake and Star Wars.

On the following Thursday, the postman delivered a package for Cameron containing his certificate and membership pack. The look of pure delight on his face and the excitement in his voice was amazing. Later the next day, I presented Cameron with his certificate and his mum photographed the event for posterity.

Cameron returned to school the next week, following the late May holiday break. In keeping with the school's policy, Cameron, who had a massive smile, was presented to the school by the Headmaster, receiving an enthusiastic round of applause from teachers and fellow students alike.

On behalf of my family, may I extend my sincere and heartfelt thanks to the organisation for making a very special and unique young man very happy. We think you are all brilliant.

Essex Ham Galleywood Scorcher

Essex Ham was active in August at another busy Field Day in Galleywood, near Chelmsford. Taking advantage of the summer weather, five stations were active, with the award for DX of the day doing to **Peter G0DZB** talking to **George W4UW** in Tennessee.

The event on August 4th was the 18th radio event of the year, many of which are organised at short notice using social media, helping Essex Hams to improve their radio skills in the field. The event also coincided with the 30th Birthday of one of the group's key members, **Kelly M6KFA**, who was honoured in the event's group photo.

A short video can be found at: **www.sxham.uk/gw818**

BRARS

The BRARS (British Railways Amateur Radio Society) AGM will be held at the Brunswick Inn in Derby on Tuesday October 23rd, commencing at 13:15. All BRARS members are entitled to attend the AGM. They are welcome to arrive any time after 11:00 for informal meet and greet and chat.

BRARS members are used to the AGMs being held on a Saturday so this Tuesday date may come as a surprise. The Society hopes that the change will not deter them from attending. The venue is conveniently near to Derby railway station. For more information about the AGM please go to the website below and follow the link from the front page.

www.BRARS.info

Significant Changes in Store for FT8 and MSK144

(from *ARRL News*) WSJT-X co-developer **Joe Taylor K1JT** has announced that major changes are coming to the FT8 and MSK144 digital protocols when WSJT-X version 2.0 arrives in a few months. Taylor said version 2.0 should be ready by January. *"Much of the necessary programming is finished,"* Taylor said in a post to the Packrats reflector. *"Many of the new features have been tested on the air, and we find them to work well."*

Taylor was quick to point out that the new capabilities are not yet publicly available, not even in beta form. He said that he, **Steve Franke K9AN** and **Bill Somerville G4WJS** have been developing *"enhanced versions of the MSK144 and FT8 protocols that extend the message payload to 77 bits."*

"Do"t rush to download something," he cautioned. *"There is more testing and code optimisation to do."* He said current plans call for a beta-testing period *"probably starting in mid-to-late September,"* with a full release *"possible a couple of months later."*

Taylor ticked off a few possibilities WSJT-X version 2.0 will bring to the table:

- ARRL Field Day operation with standard Field Day exchanges.
- ARRL RTTY Roundup operation with standard contest exchanges.
- North American VHF contest operation with full support of grid exchanges and rover (/R) callsigns.
- European VHF contest operation with the exchange of six-digit grids, QSO serial numbers, and portable (/P) callsigns.
- Better and more user-friendly support for compound and nonstandard callsigns.
- A special 'telemetry' message format for exchanging arbitrary information up to 71 bits.
- Support for the existing FT8 DXpedition Mode, with a more powerful DXpedition Mode possible too.

In most situations, decoding sensitivity will be slightly better than at present for FT8 while for MSK144 it will sometimes be about 0.5dB worse. Occupied bandwidths will be the same as they are now and false-decode rates will be significantly lower.

Taylor said WSJT-X version 2.0 will be available in time for users to digest the new documentation and to practice using the software before actually using it on the air but he offered one important caveat. *"The new protocols cannot be backward compatible with the existing ones. We will probably provide some temporary 'bilingual' capability for FT8 but not for MSK144. It will be essential for users to upgrade to version 2.0 in order to use the new features and communicate with others who have made the upgrade."*

Icom D-STAR QSO Party 2018

Icom Inc. will once again be holding a D-STAR (Digital Amateur Radio) QSO Party this year. The global event will take place between September 22nd at 0000 and September 24th at 2400UTC.

The format will be the same as in previous years with the goal of encouraging D-STAR operators to communicate with as many other operators across the world via D-STAR repeaters. The prizes on offer this year have not been announced yet, so keep an eye out for the latest updates on the D-STAR QSO Party 2018 website: **www.icom.co.jp/world/dqp**

Correction

Unfortunately, an error managed to slip through the net on the published circuit diagram of the relay paddle keyer (September, p.44). Pin 8 of contact B2 should have been connected to ground, and not to the dah contact. Also, in the previous month's *Carrying on the Practical Way* article, p.48, the 47µF electrolytic capacitor is correctly labelled but the black and white colouring is transposed.

Peterborough Club News

The weekend of July 6/7/8th was devoted to the Annual Radio FUN in the Field event. The club took to the 'wilds' of south Lincolnshire on lovely flat farmland for a weekend of antenna and rig testing plus operating on all bands, mainly SSB with a little PSK31 when conditions were poor. Members brought along their own gear or could use Club equipment. The antennas were mainly homebrew, ranging from a 4-element beam for 18MHz at 60ft and a 14MHz Moxon at 30ft to various verticals and dipoles. One member used a Clansman PRC 320 working the 40m band on a military dipole with good success. 136 contacts were made over 32 countries from Japan and Pakistan in the East to Brazil, Chile and the USA in the west along with east European, Middle Eastern and north African contacts.

New Exam Syllabus

Syllabus 2019 is now available on the RSGB website. It is provided in four files, one each for Foundation, Intermediate and Full as well as a combined document. Accompanying the syllabus documents are comparison documents prepared by the Examinations Group to help explain the changes from the previous syllabus.

A new, memorable short URL has been created to help you find them more easily: **www.rsgb.org/syllabus**

Review by Tim Kirby G4VXE

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The Anytone AT-D868UV DMR Handheld Radio

Yet another DMR handheld? Tim Kirby G4VXE looks at a dual-band DMR that has some novel features.

If you read *PW* on a regular basis, you may be forgiven for thinking 'not another DMR handheld'! Indeed, I was listening on the air this morning to a conversation about the seemingly never-ending stream of new DMR handheld radios emerging from the Chinese manufacturers.

The first iteration of DMR radios was generally single-band but since the middle of last year, there have been a number of dual-band radios coming onto the market at accessible prices. Initially, I couldn't really see why we needed dual-band models, when, after all, 99% of DMR activity on either repeaters or hotspots is on the 70cm band. As I had the chance to use a dual-band model, though, I realised this was not the whole story and there was great value in having a rig that would do DMR and FM on both bands, 2m and 70cm, so that I could use the analogue simplex and repeater channels all from the same radio.

There's been a series of these dual-band radios at a variety of price points. Although I have enjoyed using all of these, it's fair to say that many of them have had their quirks, some more noticeable than others. However, both on air and online, I'd become aware of the reputation of the Anytone AT-D868UV as a DMR dual-bander that 'just worked'. When **Chris Taylor** of Moonraker kindly offered us one to try, I was keen to see if it lived up to the billing.

What the Publicity Says

The Moonraker publicity says, "*The AnyTone D868UV radio is a VHF and UHF radio with both Digital DMR (Tier I and II) and Analogue capabilities. Offering a total of 4,000 channels (Analogue and Digital), 10,000 Digital Talk Groups and up to 150,000 contacts, as well as multiple DMR ID numbers (Radio IDs) for a single radio. This enables Moonraker to supply it preprogrammed with all UK DMR and analogue VHF/UHF repeaters. Supplied with a 3100mAh battery the radio will give a good working day's performance*".

First Impressions

The rig arrived, nicely boxed up. Included in the package are the antenna, battery, charger and AC adaptor, belt clip and a USB programming cable. There's an instruction manual too but as ever with DMR type rigs, it's of limited value because so much of the rig's functionality is defined by the codeplug (the configuration of the rig, which is software driven or defined). Having said that, the manual is well put together and describes the basic (non-codeplug) functionality clearly and accurately.

I switched on the radio and it quickly came up and had already been programmed at Moonraker with my DMR ID. The feel of the rig, in terms of the display and menu items, is very similar to the Hytera models, which to me is a very positive thing. The screen is good and clear and is visible even in the bright sunshine that we have become accustomed to this summer. The keyboard has a good positive feel to it and the menu was easy to navigate without having to reach for any instruction manuals.

Physically, the rig is comfortable in the hand and has a positive weight to it, without being heavy. I suspect that this is mostly down to the large battery, which seemed to last for ever, particularly when using the rig with a hotspot or just for listening.

The codeplug supplied by Moonraker is comprehensive and easy to use. Both Analogue and Digital (DMR) repeaters are

included, organised in regions. So, in my case, I was able to find all the analogue repeaters in the south-west region in one 'Zone' within the codeplug. With that Zone selected, I could scan across all those analogue repeaters for activity, which was quite interesting.

Testing

Actually, my first test was on DMR with my local hotspot, to check that I could receive a known DMR transmission. This was fine. The codeplug included a 'Hotspot' Zone, with entries for a hotspot on 436MHz with talkgroup 9 (and another entry for the same frequency for talkgroup 8). I connected the hotspot up to several DMR systems and was pleased to hear audio coming out of the loudspeaker, along with details of the stations' callsigns, DMR IDs and names displaying on the screen. I had a quick QSO with **Andy M1VIP** in Manchester to check things out, on the CQ-UK Fusion Room, via the DMR link, as well as with **Ivan N2XRV** from Brooklyn, New York on the Brandmeister worldwide reflector.

The Swindon DMR repeater, GB7TC, is about 15 miles from here and although it's not possible to get into it reliably with a handheld, the wonders of digital signals mean that a well-placed rig and antenna can provide very clear reception of the repeater. I found that the Anytone's sensitivity was what I would hope for and similar to the other DMR rigs I have here. I listened to the GB3TD analogue repeater at Swindon over a similar distance. Perhaps it seemed a little noisier on the Anytone than with some of my other rigs but it was copiable.

VFO Mode

Unlike some of the early DMR rigs where all you could do was to program channels in the codeplug and navigate through them in Zones, the Anytone contains a 'VFO' mode. In the codeplug as supplied by Moonraker, this is accessed by hitting the lower of the two side buttons on the left-hand side of the rig. You can then enter whatever frequency you like, within the rig's coverage. Use the numeric keypad to enter the frequency and note that you need to enter 145.650MHz as 145.65000, for example. Check whether you are in Analogue or Digital mode and if you are not in the correct mode, you can change this by going to Menu/Settings/Chan Set/Channel Type and selecting Analog or Digital as required. Note that you can do some clever stuff in there as well, transmitting on a different mode to what you are receiving. I'm not quite clear why you'd want to do that but you never know. Once you have programmed up the frequency, you can either listen on there or, if you wish, do a scan of the surrounding spectrum by hitting P1 (in the Moonraker codeplug) and it will scan up the band in whatever increments have been set in Frequency Step (this is set in settings under Menu/Settings/Radio Set), which contains a variety of useful settings, some which I haven't seen on other radios (Maximum volume, for example, along with the option to set the programmable buttons to do different things).

Digital Monitor

There is a very useful Digital Monitor feature. This allows you to monitor all talkgroups on one or both DMR timeslots, which is excellent if you are not sure which talkgroups are active on a particular channel. I was particularly impressed with the ability to monitor both timeslots because most radios I have seen recently require that you can only look at one timeslot at a time.

I realised at this stage that I had been changing all sorts of things on the radio that on earlier models of DMR radio I would have had to resort to using a computer, programming software and the programming lead for. Of course, if you are into making major changes to the codeplug, then that's what you will need to do but it was obvious with the Anytone that you could probably happily use it with the codeplug supplied without need for a computer unless, for example, a new repeater came on the scene, which you needed to program up. You might see this as an advantage if you are not an enthusiastic 'tweaker' of software.

I also noticed that the radio allows the user to set up multiple DMR IDs. This is useful when perhaps there are several amateurs in a house. With this feature, you could easily switch between different callsigns/DMR IDs.

Interfacing with a Computer

Despite saying all this, I thought I'd better find out how easy or otherwise it was to install the programming software for the Anytone and get it talking to the rig. I run a Windows 10 Virtual Machine on my MacBook Air for these sorts of tests and generally figure that if I can get it working easily in a virtual environment, then anyone using a 'real' PC should have a pretty straightforward time.

The rig has a clear and attractive display

Looking around the web, I found various places to download the programming software but chose a link on the Connect Systems website in the USA because they're a company with a good reputation. I downloaded the software and ran it to install it. Everything went according to plan. I then plugged the supplied programming lead between the rig and the computer. I checked in the Windows Device Manager and the rig had been set up as a new COM port so it was a simple matter of going into the programming software and under the Set option, selecting the COM port that had been created (COM8 in my case) and then trying to 'Read from the Radio'. To my delight it worked first time!

This is great because it means that you can take a backup of your codeplug before making changes, add new repeaters and channels and so on. Although the Anytone is very good 'standalone', I was happy to have tried the computer interface and verified that it worked easily. There's a very comprehensive guide to using the programming software and setting up the rig from a software perspective, also from

the Connect Systems website, at: https://tinyurl.com/y8lptqdh

This excellent document also includes details of how to update the firmware should you decide to do that. There are various releases of new firmware for the Anytone, which means that new features and bug fixes can be installed. This sounds alarming but once you get used to the process, it's pretty simple and is worth doing every once in a while to keep yourself up-to-date.

The GPS Receiver and Recording

The Anytone also contains a GPS receiver. As far as the rig itself is concerned, it doesn't do terribly much other than display your latitude, longitude, altitude and speed in a fairly basic list format on the screen. However, on some DMR networks it is possible to pass the GPS information to the network and have it plot your position on the APRS.FI website.

I liked the Anytone's ability to record digital audio. Note that this option doesn't seem to be available when you are in analogue mode. You can record audio clips, play them back and even send them (I didn't try that option because I'd a feeling it might not have been too popular). When you record digital audio, say a QSO, it will record each 'over' as a separate recording and you can easily see who made the transmission and at what time it was made.

Power Levels

The Anytone has four different RF power levels: low, medium, high and the rather nicely named 'turbo', which equate to 0.5/1/2.5/6W respectively. These are sensible power levels and it is useful to have a bit more granularity than I have seen on some other radios.

Programming the rig from the computer, useful for making lots of changes.

Battery Life and Charging

The rig comes with a drop-in charger and PSU. Actually, the PSU supplied with the review model was a two-pin one so I had to use an adapter to a UK mains plug, which was not a problem. I don't know how long a full charge took because I didn't manage to run the battery down completely! However, the top-up charges that I did do completed quickly. The 3300mAh battery seemed to last very well, particularly as most of my use was either through my digital hotspot or for listening.

Listening on Other Bands

The Moonraker codeplug as supplied provides receive coverage of the PMR (446MHz) band and the Marine VHF band as well as some NATS (Heathrow airport) channels. Please note that these airport channels are ground-based FM – the Anytone, sadly, does not receive Airband AM.

Conclusions

The Anytone AT-D868UV came with a good reputation as being a rig that 'just works' and that was very much my finding. It was easy to use, flexible and worked well. Unlike some of the other rigs I have used recently, albeit successfully, there were few if any quirks to work around. That was a refreshing change. If you are in the market for a dual-band, DMR/analogue handheld, the Anytone is a good value option at £139.99.

Very many thanks to Chris Taylor of Moonraker for his kind loan of the review rig.
www.moonraker.eu

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Feature by Peter E. Chadwick G3RZP

E-mail: practicalwireless@warnersgroup.co.uk

Antenna Couplers

Antenna Couplers/Aerial couplers/ATUs/Transmatches, call them what you will. Peter Chadwick G3RZP explains all.

Opinions vary about antenna couplers (or whatever you choose to call them), varying from my 'antennas are resonant so I don't need one', which illustrates a degree of ignorance – because an antenna can be resonant and still lead to a very high SWR on the feeder – to 'I always use one'. Another complication is the transceiver with a built-in automatic tuner, which may or may not be able to convert the impedance presented to it by the feeder into that which the transmitter wishes to see. A further (but not primary) reason for their use is with older transmitters (and some newer ones, especially from the US where the requirements are less stringent) in meeting the regulatory requirements regarding harmonics.

Introduction

The primary purpose of the coupler is make the impedance at the end of the feedline one that the transmitter wishes to see – usually 50Ω these days but 75Ω was fairly common in the 1950s and early 60s. This is often called 'matching the transmitter', with the implication that it is a Thévenin match, meaning that the load impedance is equal to and the complex conjugate of the source (transmitter) impedance. By complex conjugate, it is meant that the inductive and capacitive reactances of source and load cancel. Interestingly, **Hermann von Helmholtz** used the principle some 30 years before **Leon Thévenin** set forth the theorem in a clear manner. The question arises as to whether or not the transmitter is a sufficiently linear system for the principle to apply. It seems that most transmitters with a linear amplifier are, but transmitters with a Class C final stage generally are not.

A generalised equivalent series circuit of an antenna is shown in **Fig. 1**. It could be represented as the same basic components but with different values in parallel.

A resonant antenna is one where the L and C reactances are equal, while the resistor represents a number of resistances in series – these are the 'radiation resistance', which is the real part of the impedance measured at a current maximum and is the part that radiates the energy, the resistive loss in the antenna and end insulators, the induced loss caused by nearby RF absorbing objects such as close trees to a vertical and ground loss in the case of antennas fed against earth, such as verticals, inverted L and T antennas and random length wires fed against earth rather than those fed against a counterpoise, such as the W3EDP.

Series and Parallel Equivalences

At any one frequency, a resistance and reactance in series have a 'dual', that is a parallel resistance and reactance that, as far as measurements at that frequency are concerned, give exactly the same impedance. It is this duality that makes the analysis of coupler designs possible. The equations for this transformation are:

$$R_S = \frac{R_P}{1+\left(\frac{R_P}{X_P}\right)^2} \qquad X_S = \frac{R_S R_P}{X_P} \qquad \text{Equation 1}$$

$$R_P = R_S\left[1+\left(\frac{X_S}{R_S}\right)^2\right] \qquad X_P = \frac{R_S R_P}{X_S} \qquad \text{Equation 2}$$

where R_s and R_p are, respectively, the series and parallel resistances and X_s and X_p the corresponding reactances.

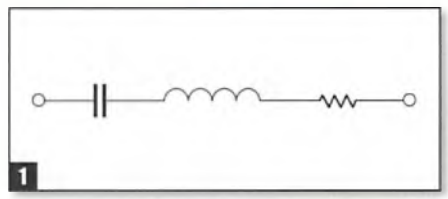
The 'L' Network

The simplest impedance transforming network is the L network, **Fig. 2**, requiring one capacitor and one inductor. To transform 'any' impedance to, for example, 50Ω, they need to be arranged in one or more ways.

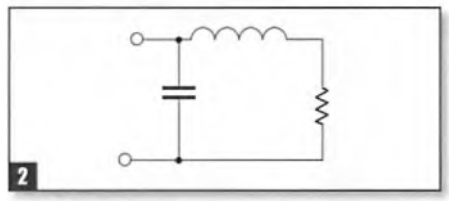
The network in Fig. 2 transforms the resistance at the load into a higher resistance at the input. This is because the inductance in series with the resistance is equivalent to a different inductance with larger resistance in parallel, see **Fig. 3** and Equation 2.

The values of the inductance and resistance are such that the Q in both cases is the same – otherwise there would not be equivalence.

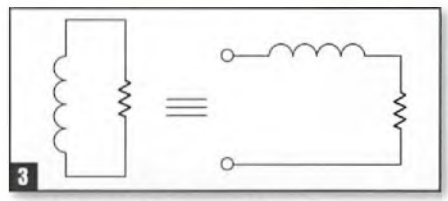
Having transformed the resistance to the required parallel resistance, the addition of a parallel capacitor causes resonance and the result is a purely resistive load presented to the RF source, **Fig. 4**.



Generalised equivalent circuit of an antenna.



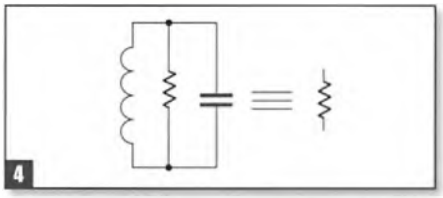
The L-network.



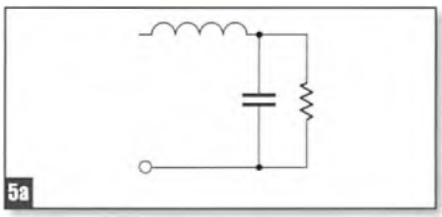
The series-parallel equivalence.

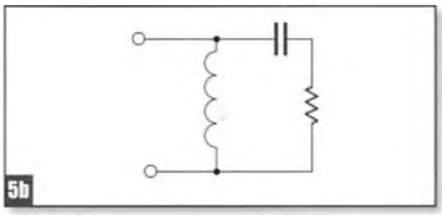
In order to transform any impedance without needing an excessive range of values of inductance and capacitance, four different circuit arrangements are required – see Figs. 2 and **5a**, **b** and **c**.

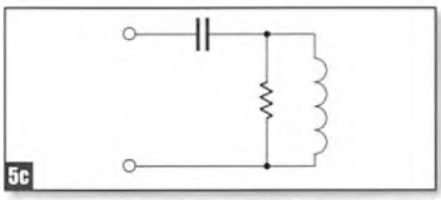
The captions are somewhat simplified since each configuration has a fairly wide range of impedance transformation ability, capable of handling various amounts of inductive and capacitive loads. The actual boundaries of the impedances that can be transformed for each circuit configuration are best demonstrated by the use of Smith Charts, which is a topic beyond the scope of this article. For those interested, in this writer's opinion, by far the best book on the subject is *Electronic Applications of the Smith Chart* by **Phillip H. Smith**, published by various US publishers over the years. Now (2018) it is apparently out of print and copies are selling for hundreds of pounds on the second-hand market but the local library may be able to obtain a copy on loan.



The addition of a shunt capacitor tunes the circuit to resonance and sees the resistor value transformed.







(a) and (b), High load resistance to low input resistance and (c) low input resistance to high load resistance.

Notice that some networks have a series inductance and shunt capacitance. This means increased discrimination against frequencies above the working frequency (a Low Pass characteristic), which can help with obtaining the necessary harmonic suppression. The other – or 'dual' circuits – have a High Pass characteristic, which can be useful in those locations where there are strong broadcast stations present in the Long or Medium wavebands.

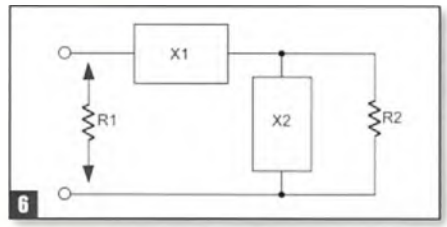
The general equations for determining the value of components in the L network are:

$$X_1 = \pm R_1\sqrt{\rho - 1}$$

$$X_2 = \mp \rho R_1\sqrt{\rho - 1}$$

Where $\rho = \frac{R_2}{R_1}$ and $\rho > 1$ (always).

It should be noted that the working Q of the L network, **Fig. 6**, is dependent on the impedance transformation ratio and that high values of working Q can prove to have higher losses – doubling the working Q doubles the current in an inductor or capacitor and so increases losses by a factor of four.



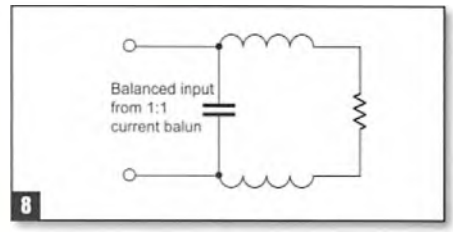
Generic L network for Equations 3 and 4.

The author's remotely-controlled L-match tuner for 160 and 80m.

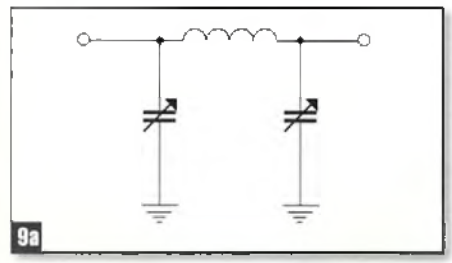
The photograph, **Fig. 7**, shows a remotely-controlled L-match tuner relay-switched between the 160 and 80m bands for a folded unipole vertical antenna having a high feedpoint impedance, over 1200Ω, with appreciable reactance and thus being required to handle high voltages and currents. Note that there is provision for local control for fault finding and testing. Mounted outdoors in a weatherproof GRP (Glass Reinforced Polyester) cabinet, it also contains a 47Ω metal-clad resistor screwed to the metal base plate and permanently dissipating some 12W to maintain a substantially condensation-free interior. The components were chosen to handle the high voltages and currents that can be present when feeding high-impedance, highly-reactive loads.

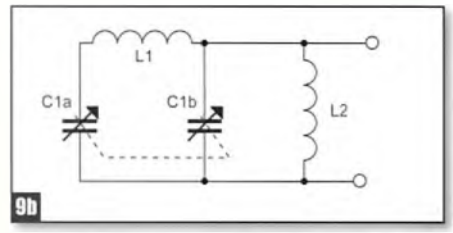
Balanced Loads and L Networks

When feeding a balanced load, one approach is to use a balun (**Bal**ance to **un**balance transformer) at the output of the L network. This can be unsatisfactory in that the balun is unlikely to be the correct impedance so may well be subject to excessive voltages or currents. The best approach is to use a current balun at the input of the network and a balanced network, as in **Fig. 8**.



L network for feeding balanced loads.





(a) The pi network and (b) the T network.

Pi and T networks

By adding a third variable to transform the L network to a pi or T form, **Figs. 9a** and **b**, the matching range is considerably extended, and many commercial antenna couplers do this. However, with some load impedances, it is possible to adjust the variables such that large currents flow in the coupler circuit itself and very little in the desired load. This is especially so in the T. In general, it is best to have the capacitors at the largest capacity value that enables a low input VSWR to be obtained.

Again, it should be noted that the pi network has a lowpass transfer function, while the T network has a high-pass function. One use of pi networks is in the input circuit of a grounded grid valved linear amplifier. In a Class AB amplifier, the anode and cathode currents have an appreciable second harmonic component, approximately 6dB below the fundamental current. Especially with solid-state exciters, which may object to a load with a high SWR, the pi network has the advantage that the output capacitor of the pi can be connected between cathode and earth right at the valve holder. Where the network is band-switched, at least the capacitor for the highest frequency band can be placed there. Such networks are usually designed for a working Q of about two to three.

Whereas the working Q in an L network is determined by the impedance transformation ratio, in the case of the pi or T networks, the value of Q is another variable that can be chosen in the design stage. There are thus four

variables – working Q and the physical values for the inductors and capacitors – these are, of course, interdependent.

The Z Match

The Z match first appeared in the US in the early 1950s. At the time, the use of the 'multiband tank circuit', **Fig. 10**, was popular. This was a circuit where one control covered all the HF bands.

The principle of the multiband tank circuit is simple. L1 with C1a and C1b in series tunes the HF bands, with L2 having little effect, while on the LF bands, L1 looks like a long lead connecting C1a and C1b in parallel. By correctly proportioning the components, there is a single control circuit that can tune 3.5 to 30MHz. One drawback is that when used as the tank circuit in a power amplifier stage, careful design is needed so that the resonant frequencies of the HF circuit do not coincide with the harmonics of the LF circuit. Multiband tank circuits of this sort were more popular in the US than the UK and were commercially available from National. This is the basis of the Z match tuner, **Fig. 11**.

L1 and L1a form an RF transformer with approximately a 1:1 ratio. Typical values for operation from 80 to 10m are for L1, five turns of 14SWG or 2mm wire, with L1 being 2.5in in diameter and L1a being 3in in diameter, mounted coaxially, with a turns spacing of about one wire diameter. L2 is also 2.5in diameter and consists of eight turns, again 14SWG or 2.0mm, with a turns spacing of one wire diameter. L2a is six turns of 3in diameter, again mounted coaxially with L2. C1 is about 250pF per section and C2 is 500pF.

Consider operation on higher frequency bands. The antenna impedance is transformed by the RF transformer to appear in series with L1, while C1a and C1b in series tune the circuit to somewhere near resonance. L2 effectively reduces to some extent the effective capacity of C1b and the inductive reactance across C1b is then converted into a low input resistance to the tuner by C2. On the lower frequency bands, L1 reduces the effective capacity of C1a and that, in parallel with C1b and the transformed impedance of the antenna with the inductance of L2, again produces an inductive impedance, which C2 again transforms to a low input resistance.

The working Q of the tuned circuits is dependent on the coupling factor of the RF transformers and the actual antenna impedance and is therefore not under the control of the operator. Certain antenna impedances can lead to very high values of working Q, leading to difficulties with coils on plastic formers melting and the capacitors flashing over.

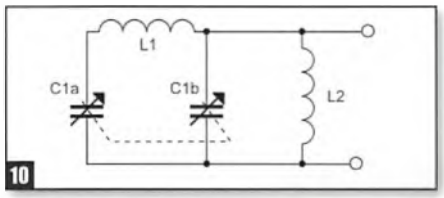
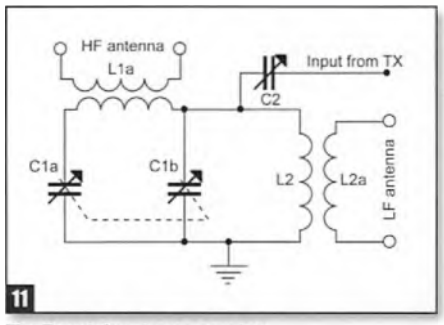
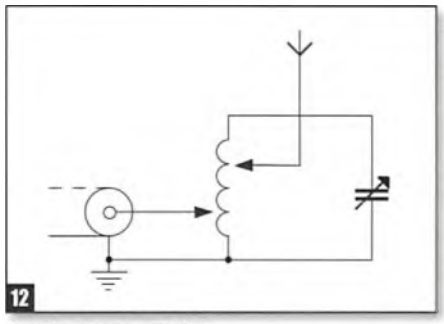


Fig. 10: The multiband tank circuit.



The Z-match antenna coupler.

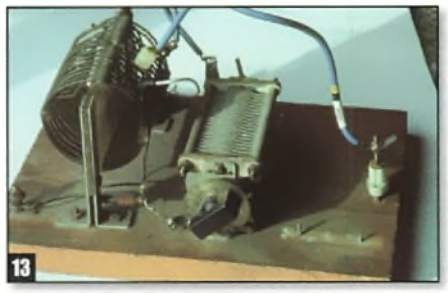


Tuned antenna coupler.

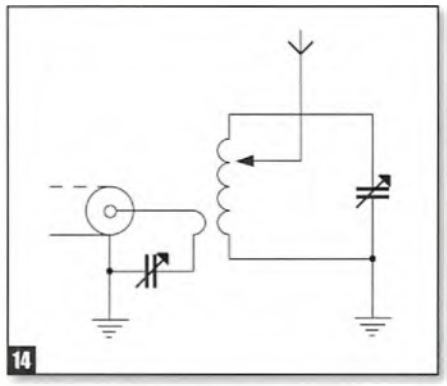
One advantage of the Z match is the ability to provide a balanced output without the use of a balun and the difficulties that can entail. However, in the circuit as shown in Fig. 11, there is no DC connection to the antenna, which can lead to problems with static build up. This can be obviated by providing a centre tap on L1a and L2a, connected to earth preferably by an RF choke so that should the tap not be completely at the electrical centre of the coil, the balance is not disturbed.

'Aperiodic' Coupling Units

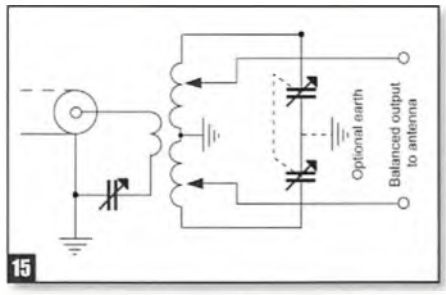
It seems that especially in the US but to a growing extent in Europe, there is reluctance, especially amongst newer operators, to make their own wire antennas, instead preferring to buy. Although trap dipoles have been sold for many years, there are now various end-fed antennas, often called 'End Fed Half Wave' or similar. One minor difficulty when applied to a multiband antenna is that the lengths for resonance on harmonics are slightly different. Many of these antennas are fed with UnUns (a shortened term for Unbalanced-to-Unbalanced transformer, in the same way that 'balun' is a contraction of Balanced-to-Unbalanced' transformer). UnUns are generally



A tuner built to the circuit of Fig. 12.



Fixed-link and series variable capacitor.

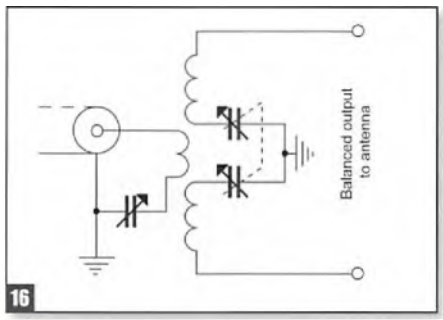


Balanced output controlled Q coupler.

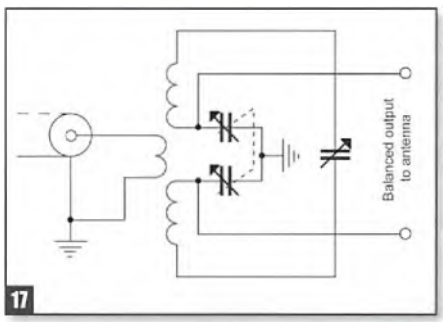
wound on a ferrite or possibly iron dust core in order to obtain wideband performance. For a true end-fed half-wave antenna, the feedpoint impedance is very high – in the region of between 2,000 and 5,000Ω, depending on height above ground, wire size and so on. The efficiency of the UnUn at such transformation ratios can become questionable, especially because at such impedances, the effects of stray capacity cannot be ignored. However, if the feed impedance to the UnUn is low enough (typically a VSWR of less than 3:1), most built-in transceiver auto-tuners can provide a match. It would be very interesting to compare the current fed into the 'End Fed Half Wave' from the UnUn coupler as compared with a tuned coupler.

Tuner Circuits with Controlled Working Q

A tuner circuit with Controlled Working Q, **Fig. 12**, is a very effective coupler, in that the working Q is controlled by the position of the taps. The value of tuning capacitor is chosen to be approximately 1.5pF/metre of wavelength, giv-



Balanced output series-tuned coupler.



Alternative balanced output series-tuned coupler.

Typical components for antenna couplers.

ing a reactance of about 380Ω. If the taps are adjusted to obtain a working Q of about 10, this means that an antenna with a resistance of 3800Ω can be matched when connected to the top of the tuned circuit. Even higher resistance values can be matched if the working Q is allowed to rise.

A practical example of such a coupler is shown in the photo, **Fig. 13**. By dint of diving in scrap bins and attending a radio club junk sale, the total cost of the coupler in 1969 was under 5p. It covered the bands 80 to 10m and even 160m with an extra capacitor attached by crocodile clips. It worked well for powers up to about 150W but, at higher power, some impedances led to capacitor arcing.

The operation can be envisaged as a tuned autotransformer, with the antenna tapped down the coil until a reasonable working Q – say between 5 and 20 – is obtained. This can be judged by the 'sharpness' of the tuning for minimum SWR. The nearer to the 'earthy' end of the coil, the higher the working Q will be.

The tuned circuit at resonance looks like a pure resistance – the 'dynamic resistance', with a value of $Q_w \omega L$ where Q_w is the working Q and ωL is the reactance of the inductor. Tapping the antenna onto the circuit will reduce the working Q, while any reactance will be compensated by adjustment of the capacitor. Rather than adjusting the input tap, it is possible to link couple with a 'swinging' link, where the link is moved into and out of alignment with the axis of the coil or, alternatively, is rotated inside the coil, providing minimum coupling when its axis is at 90° to the axis of the coil.

A very effective alternative is to use a fixed link and a series capacitor, as in **Fig. 14**. For use in a nominal 50Ω system the link winding inductance should have a reactance of about 100Ω and the series variable capacitor have a maximum value of about 9pF/metre of operating wavelength. Tight coupling between the link and the main inductor is required. For example, with a 2.5in diameter main inductor, a 1.75in diameter link inductor is mounted inside it.

Adjustment of the couplers of Figs. 12 and 14 is done by starting with low power and the antenna disconnected. The input tap in Fig. 12 starts very low on the coil and similarly the series capacitor in Fig. 12 is set to about 3pF/metre. The tuning capacitor is then adjusted for a dip in input SWR, the antenna is tapped about one-third of the way up the coil from the 'earthy' end and the input tap or series capacitor adjusted in conjunction with the tuning capacitor for minimum VSWR. If the tuning capacitor tunes very sharply, then move the antenna tap further up the coil and readjust the tuning. If the tap is too low, then full power may cause arcing in the tuning capacitor and it is probably better to err on the side of tapping too far up the coil rather than too far down.

The balanced variety of the controlled Q coupler is shown in **Fig. 15**. It is possible to earth the centre of the two variable ganged capacitors rather than the centre tap of the coil but it is then desirable connect the centre tap of the coil to earth via an RF choke to provide a drain for static build up on the antenna.

Low load impedances may give problems with obtaining sufficient coupling because of leakage inductance. Under these circumstances, series tuning is desirable as in **Fig. 16**, although the problem of bleeding static charge to earth still exists.

A variant of this is shown in **Fig. 17**. It requires tight coupling between the link winding and the tuned inductors and the voltage across the single gang capacitor can be quite high at modest powers. It can be considered as a hybrid between the pi network and the series tuned circuit and, again, the antenna has no direct earth connection for bleeding off static charge.

Components for Antenna Couplers

The photograph, **Fig. 18**, shows typical components for high power antenna couplers and even these may not be able to handle power of, say, 100W at some frequencies. For example, a 16ft long fibreglass whip antenna on a frequency of 2182kHz (the maritime MF distress frequency) would typically look like about 50pF in series with 10Ω or an impedance of 1459Ω. Fed with 100W of RF, this would result in some 4.6kV at the antenna terminal. Admittedly, this can be considered an extreme case but two or three thousand volts for an input of 400W is not an excessive amount. This means that sharp bends in conductors and sharp points of joints should be avoided. Another situation in multiband couplers using 'roller coaster' variable inductors is whether or not the unused portion of the coil should be left open- or short-circuited. If it is shorted out, then on bands where most of the coil is in use, the shorted portion can have a large current induced in it, reducing the output and heating the coil. If it is left open-circuit, then on higher frequency bands, the unused portion of the coil can resonate with stray capacity at the frequency of operation and develop a high voltage, acting very much as Tesla coil. One way to partially get around the problem is to use a construction where the variable inductor consists of a tape wound on an insulating former while the unused portion is wound on a metal former that shorts it out. This technique was used by Marconi in the D11 and D13/NT201 transmitters as well as by Collins and Plessey but has the problem of stray capacity to earth, which in itself can lead to problems, especially where parasitic resonances fall on harmonics of the operating frequency.

The majority of automatic couplers us an L network, relay-switched, with a binary bank of capacitors such as 1, 2, 4, 8, 16, 32, 64 and 128pF, which gives a range of 255pF in 1pF steps. In practice, because of stray capacity in the relays, the step size is somewhat larger. For high powers, vacuum relays are required.

It is now getting much easier to measure the feed impedance of an antenna in terms of $R \pm jX$ and, from that measurement, design a coupling unit to provide optimum efficiency. But small antennas are always a problem and such techniques as using two whips in parallel on a vehicle or two inverted-L antennas on a small fishing vessel can significantly reduce the problems of high voltage and current and inefficiencies in coupling units.

Feature by Clive Mott-Gotobed G4ODM

E-mail: G4ODM@Motts.org

Radio Direction Finding Kit: A Practical Solution

To complement our recent feature on ARDF, Clive Mott-Gotobed G4ODM describes a simple way to use your existing handheld for 2m direction finding, perhaps as part of a club Foxhunting event.

In the 'Good old Days' we had Foxhunts and our local club had one every month along with a couple of weekend specials in the New Forest. Typically, a 25km square was declared or in the case of the New Forest, one side or the other of the Landranger series New Forest Map. Great fun was had by all and we always ended up in a pub for lunch afterwards. However, although we always followed the rules of the road, eventually Political Correctness caught up with us and hunts where the major part required driving from your chosen location were replaced by Radio-Orienteering (Radio-O), which is all on foot and all off road. These are great if you are fit but if your skills were in navigating, driving, some radio construction and a short end game around a bog plus an element of luck with your chosen starting place, then Radio-O is not for you. However, some of the kit we developed during those brilliant times still works. If you or your club, **Fig .1**, want to try Radio-O on 2m and only have a 2m handheld, then read on.

There are two basic requirements to get you up and running, a directional antenna and a receiver where the sensitivity can be turned down as you close in to the transmitter and the signals get stronger and stronger. We did use home-made 2m crystal sets and these worked fine very close up even though the input frequency range was massive. Fine until the Fox goes and hides less than a mile away from the local 2m repeater. Right, let's use a dual-bander and tune to the third harmonic. That works just the once. The second time, the Fox put up both VHF and UHF signals and we walked miles until we rumbled what was going on. So, some development continued.

One solution was to make an 'Active Attenuator'. Several designs were around at the time and all mixed the incoming signal with that of a local oscillator. The designs around used simple oscillators. These tended to drift about and were correspondingly fiddly and time-consuming to use.

Fig. 1: Getting ready to go Foxhunting.

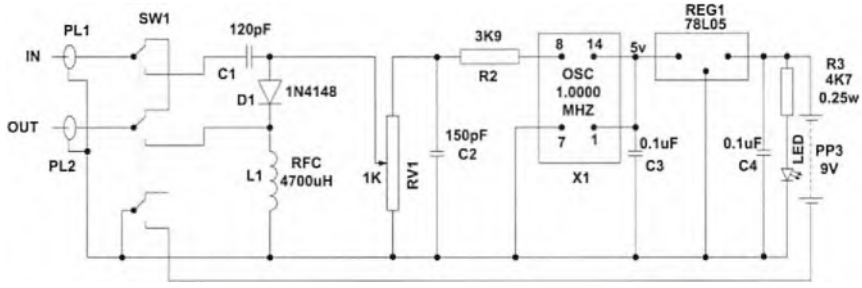


Fig. 2: Attenuator circuit.

The outcome from this was a dedicated little box that included a 1MHz oscillator module as its basis. The circuit appears as **Fig. 2** and a parts list in the sidebar. There's a three-pole switch to either bypass the box or put the diode mixer in-line and a sensitivity control. The third switch pole switches the battery line to the attenuator.

Yes, you can build one on stripboard but I went for a proper PCB, **Figs. 3** and **4**, because once it works, then they will all work.

The Technique

The technique for using the 'Active Attenuator' is as follows:

1. Start with the switch in the Straight Through position until the signal strength is overwhelming.

2. Operate the switch and turn the gain potentiometer to maximum. This will attenuate your incoming signal by 50%. As you get closer, wind back the gain control. Eventually the signal strength is again overwhelming.

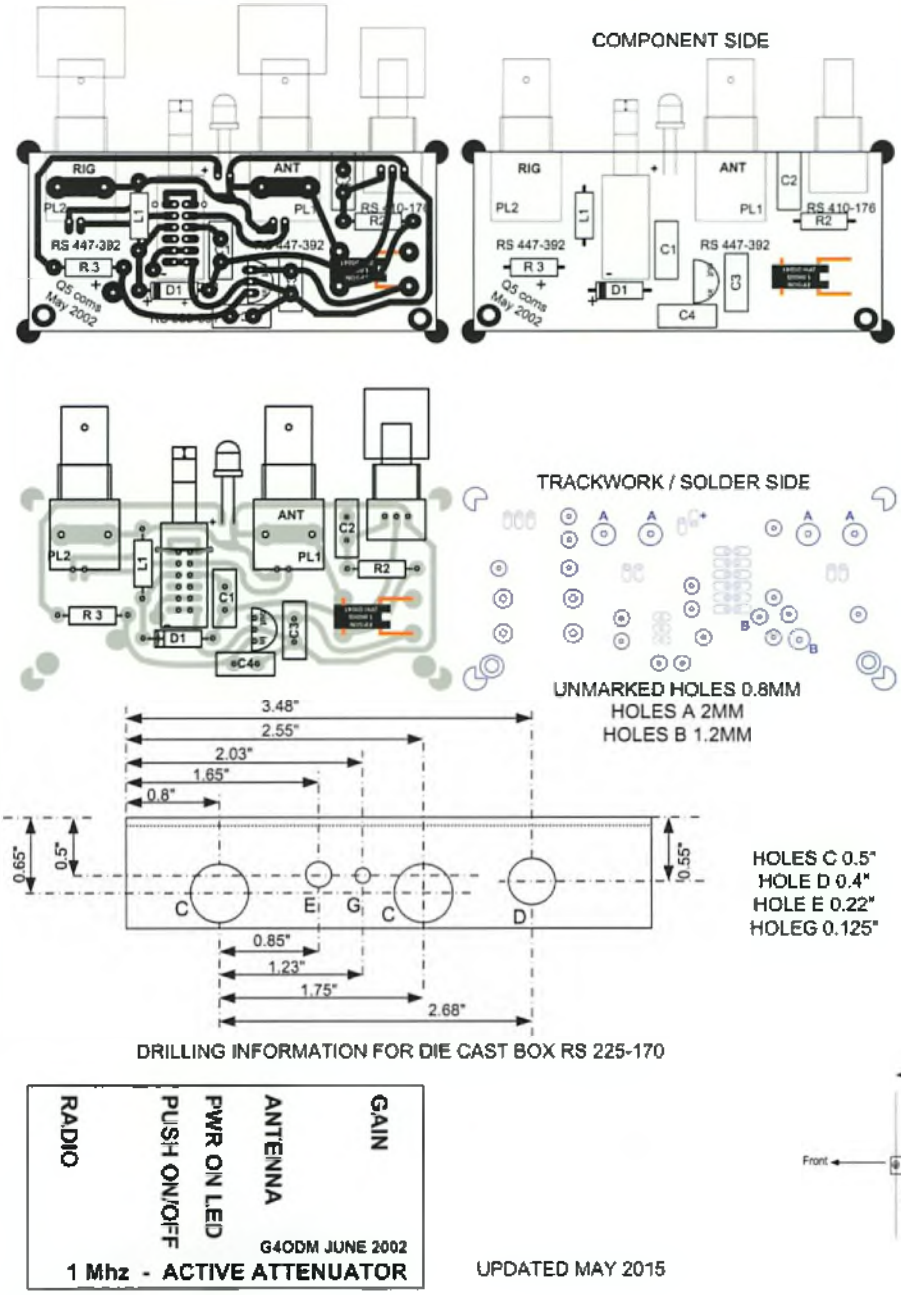


Fig. 3: Component layout, etc.

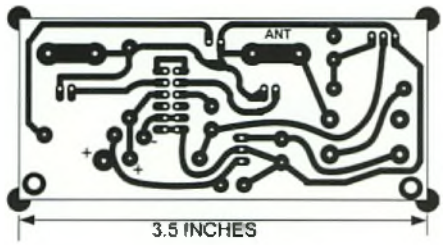


Fig. 4: Trackwork.

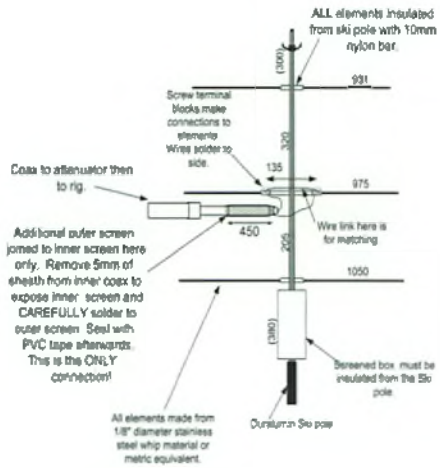


Fig. 5: 2m 3-element beam.

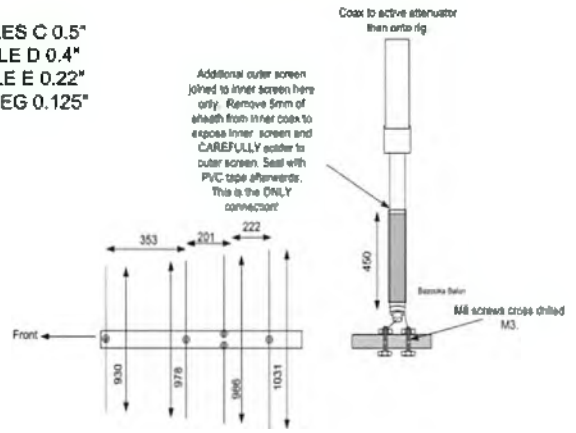


Fig. 6: 2m 4-element beam.

Parts List

Item	Component Reference	RS Components
Connector BNC 90° shielded	PLL1	546-5137
Connector BNC 90° shielded	PLL2	546-5137
Potentiometer 1kΩ	VR1	410-176
Switch 4PCO latching 90°	SW1	333-748
Button round black	BUT1	333-631
Knob	KN2	498-659
Oscillator 1MHz	X1	316-6686
Inductor 4.7mH	L1	191-0784
Capacitor 120pF	C1	167-0868
Capacitor 150pF	C2	167-0874
Capacitor 0.1µF	C3	264-4876
Capacitor 0.1µF	C4	264-4876
Resistor 3.9kΩ 1/4W	R2	131-328
Resistor 4.7kΩ 1/4W	R3	131-334
LED	LED1	223-1492
Diode 1N4148	D1	436-7341
Voltage regulator 78L05	REG1	177-5317
Box	BOX1	225-170
Battery connector, PP3	Bat1	489-021
PCB or other	PCB	

3. Tune the handset to 1MHz above or below the transmitter frequency and wind the gain back to maximum. Again, as you get closer you will need to wind the gain down again until the signal strength is overwhelming.

4. Now tune the radio to 2MHz or 3MHz above or below the transmitter frequency and wind the gain back up again.

5. You know what to do by now!

Antenna

For the antenna I use a couple of 2m directional beams, one 3-element, **Fig. 5**, and one 4-element, **Fig. 6**. The 4-element is more directional with a narrower beamwidth. I did try Tape Measure beams but found on a windy day these had a mind of their own so reverted back to 3mm diameter stainless steel whips. The funny business with the coax where it joins the antenna is a balun and this is necessary to get rid of squint. There are several methods and this is just one of them. An easy check for squint is to set up a low power transmitter or identify a repeater, point your beam towards it and note the compass reading for maximum smoke. Then flip the beam the other way up and repeat this. If the two compass bearings are the same, you have no squint and are good to go.

Give it a try. Of course, if your kit works, then you already have success.

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PS30SWIV switching power supply provides 13.8 VDC at 20 Amps continuous, 30 Amps surge. The LCD digital panel meter simultaneously displays voltage and current. There is a Noise Off-Set control that can be adjusted to eliminate pulse noise from the power supply.
SPECIAL OFFER ~~£79.95~~ **£69.95**

PS30SWII 25A continuous switch mode PSU with variable output voltage and cigar socket also includes noise offset function
SPECIAL OFFER ~~£99.95~~ **£89.95**

QJE830SB 30 AMP Linear PSU. no noise issues with the great old school power supply unit, nice digital display and heavy as you like, so you feel like you bought something and on offer this month.
SPECIAL OFFER £129.95 **£119.95**

QJE QJPS30II 30 AMP Switch Mode Power Supply Unit
Includes noise offset control to eliminate the pulse noise of the switching circuit. This patent pending function is specially designed for communication equipment use. Its effectiveness may vary depending on the frequency and mode.
SPECIAL OFFER **£79.95** **£69.95**

QJE QJPS50II 50 AMP Switch Mode Power Supply Unit
Same as above but in a 50amp version
SPECIAL OFFER **£129.95** **£119.95**

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Boxchip S700B is an advanced professional handheld 4G LTE radio all-round means of communication

Features include: Dual sim sockets ■ SD socket ■ Rugged construction ■ Gorilla Glass 111
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3. We will give you the best deal and agree the balance owed
4. Pack your equipment securely and wait for the door bell
5. Swap your old gear for shiny new with the delivery driver and enjoy! **IT'S THAT SIMPLE**

Yagi Antennas

All Yagis have high quality gamma match fittings with stainless steel fixings! (excluding YG4-2C)

YG27-3S Dual band 3/5 element 3.5/12.5 dBd gain with one feed! **£79.95**
YG4-2C 2 metre 4 Element (Boom 48") (Gain 7dBd) **£29.95**
YG5-2 2 metre 5 Element (Boom 63") (Gain 10dBd) **£69.95**
YG8-2 2 metre 8 Element (Boom 125") (Gain 12dBd) **£99.95**
YG3-4 4 metre 3 Element (Boom 45") (Gain 8dBd) **£79.95**
YG5-4 4 metre 5 Element (Boom 104") (Gain 10dBd) **£99.95**
YG3-6 6 metre 3 Element (Boom 72") (Gain 7.5dBd) **£99.95**
YG5-6 6 metre 5 Element (Boom 142") (Gain 9.5dBd) **£119.95**

ZL Special Yagi Antennas

The ZL special gives you a massive gain for the smallest boom length ... no wonder they are our best selling Yagis!

ZL5-2 2 Metre 5 Ele, Boom 95cm, Gain 9.5dBd **£69.95**
ZL7-2 2 Metre 7 Ele, Boom 150cm, Gain 11.5dBd **£79.95**
ZL7-70 70cm 7 Ele, Boom 70cm, Gain 11.5dBd **£49.95**
ZL12-70 70cm 12 Ele, Boom 120cm, Gain 14dBd **£59.95**

HB9CV

Brilliant 2 element beams ... ideal for portable use

HB9-2 ..... **£34.95**
HB9-4 ..... **£49.95**
HB9-6 ..... **£59.95**

Halo Loops

Our most popular compact antennas, great base, mobile, portable, or wherever!

HLP-4 4 mtr (size approx 800mm square) **£44. 95**
HLP-6 6 mtr (size approx 800mm square) **£49.95**

QRP Antennas

The Moonraker Whizz range are great for getting on HF in a neat compact and totally portable way

Whizz Whip HF/VHF/UHF portable antenna with telescopic whip - ideal for any situation where a long wire or vertical antenna is just not an option - get on air today for **just £99.95**

Whizz Loop 20-60m compact loop is ideal for QRP Transceivers when space is limited or using portable with a Yaesu FT-817ND or similar. Can be used indoors with surprising results and handy for travelling due to its "pocket" size antenna ideal for indoor or out and can be packed away and all for just **£69.95**

Whizz Loop V2 (right) same as above but with a frequency range from 40-10m **£79.95**

Base Antennas

Simple plug and play HF antennas radial free and at a great price

GP2500 All Band 80-6M Vertical TX 80-6M RX 2-90MHz. Power 250W Length 7.13M **£199.95**
GPA-80 budget version of GP2500 80-6M Length 6.0M **£99.95**

Portable HF Kits

Great dual band kits for portable use, two compact dipoles on an upto 14ft mast just requires coax

PK1217 HF Kit for 12/17M **£149.95**
PK1520 HF Kit for 15/20M **£149.95**
PK3060 HF Kit for 30/60M **£154.95**
PK4080 HF Kit for 40/80M **£159.95**
(please note each kit requires two feeds)

Mobile Antenna Mounts

TRIMAG-S Triple magnetic mount with SO239 antenna fitting with 4m RG58 and PL259 fitted – ideal for those larger antennas ..... **just £39.95**
TURBO-S single 170mm magnetic mount with SO239 antenna fitting with 4m RG58 and PL259 fitted – will suit most antennas upto 5ft **£19.95**
HKITHD-SO Heavy duty hatch back mount with SO239 antenna fitting with 4m RG58 and PL259 fitted **£32.95**
HKITM-S Mini hatch back mount with SO239 antenna fitting with 4m RG58 and PL259 fitted **£32.95**

Multiband Mobile

Why buy loads of different antennas when Moonraker has one to cover all!! SPX series has a unique fly lead and socket for quick band changing

SPX-100 9 Band plug n' go portable. 6/10/12/15/17/20/30/40/80m, Length 165cm retracted just 0.5m, Power 50W complete with 38th PL259 or BNC fitting to suit all applications, mobile portable or base - brilliant! **£44.95**

SPX-200S 6 Band plug n' go mobile, 6/10/15/20/40/80m, Length 130cm, Power 120W, PL259 fitting **£44.95**
SPX-300S 9 Band plug n' go mobile, 6/10/12/15/17/20/30/40/80m, Length 165cm, High Power 200W,PL259 fitting **£59.95**

VHF/UHF Mobiles

GF151 Glass Mount 2/70cm, Gain 2.9/4.3dBd, Length 78cm complete with 4m cable and PL259 ..... **£29.95**
MRM-100 MICRO MAG 2/70cm, Gain 0.5/3.0dBd, Length 55cm, 1" magnetic base with 4m coax and BNC **£19.95**
MR700 2/70cm, Gain 0/3.0dBd, Length 50cm, 3/8 fitting **£9.95**
MR777 2/70cm, Gain 2.8/4.8dBd, Length 150cm, 3/8 fitting **£19.95**
MRQ525 2/70cm, Gain 0.5/3.2dBd, Length 43cm, PL259 fitting (high quality) **£19.95**
MRQ500 2/70cm, Gain 3.2/5.8dBd, Length 95cm, PL259 fitting (high quality) **£26.95**
MRQ750 2/70cm, Gain 5.5/8.0dBd, Length 150cm, PL259 fitting (high quality) **£36.95**
MRQ800 6/2/70cm Gain 3.0dBi/5.0/7.5dBdBd, Length 150cm, PL259 fitting (high quality) **£39.95**
MRQ273 2/70/23cm Gain 3.5/5.5/7.5dBdBd, Length 85cm, PL259 fitting (high quality) **£49.95**
MRQ900 10/6/2/70cm Gain 10m (2.15dB) 6m(2.5dB) 2m (2.8dB) 70cm (5.5dB) **Length:** 125cm PL259 fitting **£49.95**

Coax Switches

CS2D1 2 Way Switch 3 X SO239, 2500W 1-1000MHz **£19.95**
CS2D1N 2 Way Switch 3 X N-Type, 2500W 1-1000MHz **£24.95**

Lightning Arrestors

ST-1 SO239 to PL259 adapter with earth wire connection **£4.95**
COX-1 Lightning Arrestor 2 X SO239 sockets 400W **£19.99**

Dummy Loads

DL-15 PL259 DC-800MHz 15W CW 20W 50 Ohms **£24.95**
DL-15N N-Type DC-800MHz 15W CW 20W 50 Ohms **£29.95**

SWR Meters

SWR-100 Frequency 26-30MHz 100W 50 Ohms **£16.95**
SWR-270 Frequency 120-500MHz 100W 50 Ohms **£29.95**

Ferrites

High quality ferrites to suit all the popular cables
FCS-S to suit 6mm cable such as RG58 ..... **£1.95**
FCS-M to suit 7mm cable such as MINI8 ..... **£2.95**
FCS-L to suit 9mm cable such as RG213 ..... **£3.95**

GRP Fibreglass Base Antennas Diamond quality – Moonraker pricing

Diamond quality – Moonraker prices ! These high gain antennas have been pre-tuned for your convenience, easy to use, easy to install, and a choice of connection ... look no further

SQBM100P 2/70cm 3.00/6.00dBd. RX 25-2000MHz, Length 100cm SO239 ..... ~~£49.95~~ **special offer £39.95**
SQBM200P 2/70cm, Gain 4.5/7.5dBd, RX 25-2000MHz, Length 155cm, SO239 ..... ~~£54.95~~ **special offer £44.95**
SQBM500P 2/70cm, Gain 6.8/9.2dBd, RX 25-2000MHz, Length 250cm, SO239 ..... ~~£74.95~~ **special offer £69.95**
SQBM1000P 6/2/70cm, Gain 3.0/6.2/8.4dBd, RX 25-2000MHz, Length 250cm, SO239 ..... **£84.95**
SQBM223N 2/70/23cm, Gain 4.5/7.5/12.5dBd, RX 25-2000MHz, Length 155cm, N-Type **£79.95**
SQBM4010P Quadband 10/4/2/70cm Gain 2.5/3.2/3.6/5.5dBi Length 120cm **£69.95**
SQBM6010P Quadband 10/6/2/70cm Gain 2.5/3.0/3.6/5.5dBi Length 120cm **£69.95**
SQBM4060P Quadband 6/4/2/70 Gain: 2.5/3.0/3.6/5.5dbi Length 120cm **£69.95**

HF Wire Antennas

All our HF wire antennas are made with complete waterproof potted baluns and high quality "original" flexweave antenna wire.

MDHF-80 3.5MHz balun matched mono dipole, length 40m **£59.95**
MDHF-40 7.0MHz balun matched mono dipole, length 20m **£44.95**
MDHF-20 14MHz balun matched mono dipole, length 10m **£39.95**
OSHF-80 3.5-30MHz balun matched off set dipole, length 40m **£59.95**
OSHF-40 7.0-30MHz balun matched off set dipole, length 22m **£44.95**
OSHF-20 14-30MHz balun matched off set dipole, length 11m **£39.95**
LWHF-160 1.8-50MHz unun match end fed antenna, length 42m **£49.95**
LWHF-80 3.5-50MHz unun match end fed antenna, length 20m **£44.95**
LWHF-40 7.0-50MHz unun match end fed antenna, length 10m **£39.95**

HF Mobiles

Get great results with the Moonraker range of HF mobiles! From as little as £22.95!

AMPRO-10 Slim line design 28MHz 2m approx. 3/8th fitting **£22.95**
AMPRO-11 Slim line design 27MHz 2m approx. 3/8th fitting **£22.95**
AMPRO-12 Slim line design 24MHz 2m approx. 3/8th fitting **£22.95**
AMPRO-15 Slim line design 21MHz 2m approx. 3/8th fitting **£22.95**
AMPRO-17 Slim line design 18MHz 2m approx. 3/8th fitting **£22.95**
AMPRO-20 Slim line design 14MHz 2m approx. 3/8th fitting **£22.95**
AMPRO-30 Slim line design 10MHz 2m approx. 3/8th fitting **£22.95**
AMPRO-40 Slim line design 7MHz 2m approx. 3/8th fitting **£22.95**
AMPRO-60 Slim line design 5MHz 2m approx. 3/8th fitting **£24.95**
AMPRO-80 Slim line design 3.5MHz 2m approx. 3/8th fitting **£27.95**
AMPRO-160 Slim line design 1.8MHz 2m approx. 3/8th fitting **£59.95**

Other frequencies available. Call or see online for more details.

Baluns & Ununs

High quality TX, RX baluns, and Ununs all fully potted and weather protected with SO239 socket

MB-1 1-30MHz 1:1 Current Balun 400W 50 Ohms **£29.95**
MB-4 1-30MHz 4:1 Current Balun 400W 50 Ohms **£29.95**
MB-6 1-30MHz 6:1 Current Balun 400W 50 Ohms **£29.95**
MB-1X 1-30MHz 1:1 Current Balun 1000W 50 Ohms **£39.95**
MB-4X 1-30MHz 4:1 Current Balun 1000W 50 Ohms **£39.95**
MB-6X 1-30MHz 6:1 Current Balun 1000W 50 Ohms **£39.95**
MU-9 1-50MHz 9:1 Unun 500W 50 Ohms **£29.95**
LWB-1 0-40MHz Receive only 50 Ohms **£24.95**

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Base

FT-DX3000 HF/50MHz 100W Transceiver **£1449.00**
FT-DX1200 HF/50MHz 100W Transceiver **£929.00**
FT-991A HF/50/144/430 MHz All mode field transceiver **£1199.00**
FT-4500 HF/50MHz entry level transceiver **£569.00**

Mobile/Portable

FT-857D HF/VHF/UHF 160-70cm 100W SSB/AM/CW/FM Transceiver **£685.00**
FT-891 HF/50MHz 160-6m 100W all mode transceiver **£589.00**
FT-817ND HF/VHF/UHF 160-70cm 5W backpack transceiver **£525.00**
FTM-400XDE Dual band 2/70cm digital mobile transceiver **£479.00**
FTM-100DE Dual band 2/70cm digital mobile transceiver **£299.00**
FT-8900 Quad band 10/6/2/70cm mobile transceiver **£269.00**
FT-7900 Dual band 2/70cm mobile transceiver **£249.00**
FTM-3200DE 2m digital mobile transceiver **£179.00**
FT-2980E 2m FM 80W mobile transceiver **£149.00**
FTM-3100DE 2m analogue transceiver **£129.00**

Handheld

FT-70DE Digital dual band 2/70cm handheld transceiver **£379.00**
FT-70DE Digital dual band 2/70cm handheld transceiver **£189.00**
VX-80E Triband 6/2/70cm handheld transceiver **£289.00**
VX-6E Dual band 2/70cm handheld transceiver **£159.00**
VX-3E Dual band 2/70cm handheld mini transceiver **£139.00**
FT-65E Dual band 2/70cm entry level handheld transceiver **£89.95**
FT-25E Single band 2m band transceiver **£69.00**

TYT

Now you can go digital on the road with the TYT MD-9600 DMR Digital Mobile Two-Way Radio! The MD-9600 gives you crystal clear, noise-free audio of over-the-air digital communications in your vehicle, full analogue transceiver capabilities, and bundles it all together at a price you can afford!! **£279.95**

Inrico®

TM-7 Network Mobile Radio £139.95
Android based POC Radio (PTT over Cellular)
The Inrico TM-7 network radio is the first mobile network Radio. Great for amateur radio use with the new IRN platform, for Zello, Team Speak 3 and Echolink via 3G or WiFi. And it works as WiFi hotspot too!

T320 4G/WiFi Network Handheld Radio £169.95
This radio is cellular so works like a walkie talkie but uses the cellular network as a repeater! This means hand held to hand held or handheld to mobile comms around the world. Companies like ID offer a suitable sim with EU roaming from £3.99 a month or if you are in the UK Freedompop is available otherwise you can use it on WiFi! Using Apps like Zello & Teamspeak you can talk privately for just the cost of your sim! Please note this radio does not transmit on the amateur bands For the Radio amateur you can link to many networks using the International Radio Network For the non-amateur think of it as well behaved CB with worldwide coverage or Private 1 to 1 calls! For the private use all the advantages of cell phone coverage while looking professional Please note this version uses unlocked Android and allows you to fully utilise the PTT functions

Features

- Intelligent Global Intercom • More than 80 Hours standby time
- Dual chamber speaker to give Enhanced audio • GPS built in
- Micro 5 pin data line • Supports MP3 & MP4 • 2.4 Inch High Quality Screen
- Extended memory up to 32GB • Waterproof IP54

DMR Dual Band Transceiver

MOONRAKER

Dual Band DMR has arrived with twice the fun with the MOONRAKER HT-5000 Dual Band DMR Digital & Analogue hand held Radio!
The HT-5000 takes the experience of DMR to a new level with features designed for the amateur radio user.
Amazing value £199.99!

MT-270M

Dual band mobile transceiver
136-174/400-450MHz 25W
Amazing value £79.95!

MT-SC Software cable **£9.95**
MT-DC Cigarette lighter and power cable **£9.95**
MT-RM Replacement microphone **£12.95**

PRESIDENT

Ronald

10/12m mobile transceiver
AM/FM 50W+ PEP
Amazing value £169.95!

Lincoln II Plus 10/12m mobile transceiver AM/FM/LSB/USB/CW 35W **£239.95**

AnyTone

AT-778UV

Dual band 136-174/400-490MHz
30W FM mobile transceiver
Amazing value £99.95!

AT-D868UV

VHF/UHF DMR Handheld **£139.95**
The AnyTone D868UV radio was developed to conform to the DMR Tier I and II requirements. The radio offers 4,000 Channels, 10,000 Digital Talk Groups with 150,000 Contacts. The large colour display offers clear information about the radio operation and function, including displaying who you are connected to. The powerful transmitter is very reliable and offers up to 7 Watts of power for a hand-held. The Anytone AT-D868UV has been designed for radio amateurs and has the ability to take the radio outside of the code plug in VFO mode (Single button press) So it is a dual band Hand held with DMR rather than a DMR radio with a dual band handy!

LEIXEN

VV-898 £59.95
Dual Band
136-174/400-470MHz 10W
mobile transceiver
VV-898S Dual Band 136-174/400-470MHz 25W mobile transceiver **£69.95**
VV-898SP Dual Band 136-174/400-470MHz 25W mobile backpack transceiver, this mobile backpack transceiver you can take virtually anywhere you need it! Leixen combined their micro-compact, 25 watt Dual Band UHF/VHF Mobile Radio with a powerful 12A Li-ion rechargeable battery and put it all in a sturdy chassis you can fit in your pack or emergency bag for use anytime, anywhere!.. **£149.95**
VV-8SC software and cable for all Leixen transceivers

WHISTLER

Moonraker have worked with Whistler to customise a UK band plan for the scanners! This ensures the radios cover UK bands in the correct steps and the correct mode. When a user does a service scan it will search in the correct steps for the selected band ensuring maximum received stations. The radios will receive both amateur and commercial DMR transmissions, as (apart from the frequency) they are fundamentally the same mode. The radio is supplied with software and users can select mode when writing memories or select auto and it will work out the mode itself!
TRX-1 25-1300MHz Digital Handheld Scanner (left) **£419.95**
TRX-2 25-1300MHz Digital Base Scanner (right) **£479.95**

ICOM

Base

IC-7610 HF/50MHz SDR base transceiver **£3499.95**
Following on from the technology incorporated into the IC-7300, the IC-7610 adopts the same RF direct sampling system for signal processing. By converting the analogue signal directly to a digital signal and processing it within the FPGA (Field Programmable Gate Array), it provides improved transmission phase noise and excellent RMDR of 105 dB (at 1 kHz detuning).

IC-7300 HF/50/70MHz base transceiver **£1199.00**
The IC-7300 is a revolutionary compact radio that will excite HF operators from beginners to experts. This new model has a high-performance real-time spectrum scope and employs a new RF direct sampling system.

Mobile

ID-4100 D-Star dual band mobile transceiver **£475.00**
The ID-4100 makes using DSTAR more fun and more comfortable thanks to the terminal mode / access point mode for the first time in mobile devices . This feature enables DSTAR via the Internet from any location you do not have access to a DSTAR repeater.
IC-2730E Dual band mobile transceiver **£289.00**
This stunning new dual band mobile transceiver features a large high-contrast LCD screen with backlight, V/V and U/U simultaneous receive capability and optional Bluetooth® connectivity for hands-free and remote control communications.

Handheld

ID-51E PLUS2 D-star dual band handheld transceiver **£379.00**
This is the third generation of the successful D-Star handheld transceiver. Like the original ID-51E, it covers 2 meters and 70cms and receives two bands simultaneously (V/V, U/U & V/U)

BAOFENG

New version of this ever popular handie - and now with a 4.5W on 2m - Comes complete with desktop charger, antenna, belt clip & high power 1800mAh battery and now with FREE earpiece all for less than £30!

UV-5RC+ Dual band 136-174/400-480MHz 4.5W handheld transceiver **£29.95**
BL-5 Replacement 1800mAh battery **£12.95**
UV-5SM Fist speaker microphone **£9.95**
UV-5BE Battery eliminator **£9.95**
UV-5SC Soft case **£9.95**
UV-5PC Software cable **£9.95**

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Baofeng DM-5HK DMR Digital & Analogue Transceiver **£89.95**

Another great product from Baofeng making DMR affordable to everyone. Comes complete with high gain antenna, belt clip, hand strap, desktop charger, 3800mAh battery, user manual and earpiece

- Text receiving and sending with at most 64 characters.
- Frequency editing under Channel mode
- Digital Monitor Mode..support communication when frequency, time slot and colour code is paired, regardless of Contact ID, RX Group list

Customize shortcut keys: including long-press and short-press with Side Keys. Edit shortcut keys with Programming Software.

- Support analog repeaters and digital ones
- Dual-standby and dual display
- Driver-free programming cable, plug and play

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Arrow Antennas

ARROW II 146/437-10WBP £149.99
ARROW II 146/437-14WBP £199.99
ROLL UP BAG to suit either £59.95

Alpha Antennas

ALPHA ANTENNA complete multiband loop for 10-40m + tripod & bag £349.95
The rugged & waterproof Multiband Loop is a complete HF antenna that transmits from 10-40 meters and has low noise receive capabilities from 7.0MHz to 29.7MHz. It can be assembled in less than 60 seconds even with thick winter gloves on. It is directional, packable into less than 25% the space of any other, and at 1.3 Kg (3 pounds), which includes Tripod, Bag, and Antenna, it is the lightest Complete Magnetic Loop ever made.

ALPHA ANTENNA 10-40M ALPHA LOOP JR with 6:1 reduction drive (inc tripod+bag) £399.95
A personal favourite of the Founder of Alpha Antenna, Steven Delnes/NOTES. The Alpha Loop Jr+ for most CAP (SHARES), MARS, and Amateur Radio frequencies offers you a light 6.350MHz to 29.7MHz 15 watt PEP SSB transmit/receive antenna in a small package that deploys in approximately 60 seconds, which now has a 6:1 reduction drive.

ALPHA ANTENNA 6-80M complete multiband tuner free hf antenna £399.95
Directional Multiband System definition. A complete directional 500W PEP SSB multipurpose antenna, which can be configured to launch your signal as circumstances require from 6 through 80 metres.

ALPHA ANTENNA 6-160M J-POLE JR 34FT ANTENNA . £179.95
The Alpha J-Pole Jr Antenna is only 34 feet in length. The unique design characteristics of this 6-160 Meter HF JPole antenna enables it to approach resonance on the major HF bands

Tarheel Antennas

LITTLE TARHEEL II MOTORISED 80-6MHF ANTENNA 3.5-54MHz £449.95
When properly installed on your vehicle this antenna will provide continuous coverage from 3.5 to 54 MHz with the supplied whip. The Little Tarheel II antenna like all Tarheel motorized antenna models are built to meet the highest standards but in a more user friendly size. This antenna comes with the sensors already pre-installed so if you decide to add one of the auto controllers (SDC-100 Simple Controller, SDC-102 Programmable Controller, Turbo Tuner, Antenna BOSS and BOSS-I) now or later everything is ready. This antenna has been designed for the person who wants to enjoy HF mobile but prefers smaller antennas. Don't let the small size fool you because when mounted higher on the vehicle you have less ground loses equalling higher performance

OTHER MODELS
BABY TARHEEL MOTORISED 40-6M HF ANTENNA 7-54MHz £399.95
LITTLE TARHEEL II-HP MOTORISED 40-6M HIGH POWER HF ANTENNA 7-54MHz £449.95
TARHEEL 40A-HP MOTORISED 40-10M HIGH POWER HF ANTENNA 7-34MHz £499.95
TARHEEL M100A-HP MOTORISED 80-10M HIGH POWER HF ANTENNA 3.4-30MHz £529.95
TARHEEL M200A-HP MOTORISED 80-11M HIGH POWER HF ANTENNA 3.4-28MHz £529.95
TARHEEL M300A-HP MOTORISED 160-10M HIGH POWER HF ANTENNA 1.7-30MHz £499.95
TARHEEL M400A-HP MOTORISED 160-10M HIGH POWER HF ANTENNA 1.7-30MHz £529.95

CHAMELEON ANTENNA™

CHAMELEON CHA F-LOOP PLUS 2.0 £549.95
The Cha F-Loop Plus 2.0 was designed with portability, ease of use simplicity, ruggedness and high performance in mind. Unlike any other similar antennas on the market, it is made with premium materials that are precisely manufactured and assembled in the USA! This is an exciting new product from Chameleon Antenna. Easily deployable HF magnetic loop antennas, also called small transmitting loops, have been routinely used for many years in military, diplomatic, and shipboard HF communication links, where robust and reliable general coverage radio communication is a necessity.

OTHER MODELS
CHAMELEON CHA F-LOOP 2.0 ..... £449.95
CHAMELEON CHA P-LOOP PORTABLE HF ANTENNA £549.95

CHAMELEON CHA SKYLOOP 3.0-54 MHZ HF BASE ANTENNA £149.95
The CHA SKYLOOP is a 250' (14 gauge) full wave loop antenna cut for 80M. A yard of at least 60' X 60' will be required to install and support the antenna properly. With the help of an antenna tuner the CHA SKYLOOP will cover all the bands between 80M and 6M included. To match the loop to the coax cable a high power 4:1 air core balun (1000W CW) has been inserted in a waterproof container at the feeding point of the antenna. Even if the antenna can be installed at a minimum of 10' above ground the antenna should be ideally installed at least 30' to 40' off the ground for maximum performance. The antenna will be suspended by four evenly spaced support points. The main advantages of a sky loop are the reduced background noise and a better gain over a dipole

CHAMELEON CHA TD PORTABLE 1.8-30MHZ ANTENNA . £399.95
The CHA TD (Tactical Dipole) is a HF broadband antenna specially designed for portable HF communication where rapid deployment and simplicity of operation is essential.

CHAMELEON CHA TD LITE PORTABLE 1.8-54MHZ ANTENNA £159.95
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Feature by Dr Bruce Taylor HB9ANY

E-mail: bgtaylor@iee.org

The Transistor Revolution (Part 1)

Dr Bruce Taylor HB9ANY describes the invention of the tiny device that changed the course of radio history.

At Christmas 1938, working in their small rented garage in Palo Alto, California, two enterprising young men called Bill Hewlett and Dave Packard finished designing a novel wide-range Wien bridge VFO. They took pictures of the instrument sitting on the mantelpiece in their house, made 25 sales brochures and sent them to potential customers. Thus began the electronics company that by 1995 employed over 100,000 people worldwide and generated annual sales of $31 billion. The oscillator used five thermionic valves, the active devices that had been the mainstay of wireless communications for over 25 years.

But less than a decade after HP's first product went on sale, two engineers working on the other side of the continent at Murray Hill, New Jersey, made an invention that was destined to eclipse the valve and change wireless and electronics forever. On December 23rd 1947, **John Bardeen** and **Walter Brattain** at Bell Telephone Laboratories (the research arm of AT&T) succeeded in making the device that set in motion a technological revolution beyond their wildest dreams. It consisted of two gold contacts pressed on a pinhead of semi-conductive material on a metallic base.

The regular News of Radio item in the 1948 *New York Times* was far from being a blockbuster column. Relegated to page 46, a short article in the edition of July 1st reported that CBS would be starting two new shows for the summer season, *"Mr Tutt"* and *"Our Miss Brooks"*, and that *"Waltz Time"* would be broadcast for a full hour on three successive Fridays. But right at the end, after another unexciting story about the broadcasting of road traffic reports, the article mentioned that Bell Labs had demonstrated a small metal cylinder that could *"create and send radio waves"* but contained *"no vacuum, grid, plate, or glass envelope to keep the air away"*. It could amplify and oscillate and had been named a *"Transistor"*.

The name had been chosen by internal ballot among Bell Labs executives and research staff. Semiconductor Triode and Surface States Triode were considered fairly good but unwieldy, and Transistor came out well ahead of Crystal Triode, Solid Triode and Iotatron. Little did the apathetic NYT reporter realise that he had witnessed the first public demonstration of an invention that would spawn a world-changing technology.

Quite independently, **Herbert Mataré** in June 1948 also invented the point-contact germanium transistor, which he called a Transitron, while working for CFS Westinghouse near Paris. By mid-1949 many of them were in use as amplifiers in the French telephone system. At this time European industry was still recovering from the devastation of war but research at UK companies such as BTH, GEC and STC was not far behind the US and their first products were named Crystal Valve and Germanium Triode as well as Crystal Triode.

The point contacts of the first transistor were created by a razorblade slit in gold foil wrapped around the edge of a triangular plastic wedge. (Bell Labs)

Origins

The roots of the invention were much older. The rectifying properties of crystals had been discovered by **Karl Braun** in 1874, before wireless existed, and the cat's whisker detectors that became popular in the early 1900s were semiconductor diodes in all but the name. Nor was the concept of a three-electrode solid-state amplifier a new one. As far back as 1926, the German-American engineer **Julius**

Research Director Ralph Bown introduces the first point-contact transistor to the press. (Bell Labs)

To the chagrin of Walter Brattain (right) and John Bardeen (glasses), Bill Shockley insisted on sitting at their workplace for this posed Bell Labs publicity photo. (Bell Labs)

Lilienfeld, who patented a forerunner to the modern electrolytic capacitor, filed a patent for an FET-like device that was granted in 1930. Since materials of the purity required weren't available at the time, it is unlikely that Lilienfeld succeeded in making a working transistor but his claim was strong enough to prevent Bell Labs from patenting the field-effect approach 18 years later.

The theoretical foundations for transistor operation were laid in 1931, when Cambridge University mathematician **Alan Wilson** formulated the quantum mechanical theory of conduction in semiconductors. He correctly attributed their properties to the presence of impurity atoms in the crystals, opening the way for less empirical work on solid-state devices. During WW2, Wilson worked on radio communications for the secret Special Operations Executive (the 'Ministry of Ungentlemanly Warfare') and later on the UK project to develop the atomic bomb. He was knighted in 1961.

With the development of the high-power 10cm cavity magnetron by **John Randall** and **Harry Boot** at Birmingham University, high resolution microwave radar became feasible if a reliable detector could be found. After Bell Labs were unsuccessful in developing thermionic valves for this very short wavelength, attention was turned once again to cat's whisker crystal diodes. In Britain, the Telecommunications Research Establishment (TRE) developed an aluminium-doped silicon cartridge that was manufactured by BTH and GEC. While at TRE, the eccentric Bristol physicist **Herbert Skinner** improvised a technique for finding a sweet spot for the contact by tapping the crystals with an old pipe-cleaner knife and these detectors famously outperformed those that were not optimised in this way. He refused to allow anyone to clean the dirty knife, which had acquired *"exactly the right momentum for the job"!*

This war effort also gave rise to the next important breakthrough. While working on radar detectors in 1940, Bell Labs chemist **Russell Ohl** made the fortuitous discovery of a rectifying junction at a defect in a bar of silicon and noted its photovoltaic behaviour. Ohl had been bitten by the radio bug when using spark transmitters on 150m during WW1 and had built a superhet as early as 1921. He coined the terms n-type, for material containing some atoms of phosphorus, antimony or arsenic (in which conduction is by electrons), and p-type, for material containing some atoms of boron, aluminium or gallium (in which conduction is by holes), and the p-n junction was born. Initially this discovery wasn't disclosed outside Bell Labs, and Ohl was instructed to cut any chance p-n junctions out of silicon that was sent to his British counterparts.

Bell Labs

Work on semiconductors at Bell Labs had begun before the war, and energetic boss **Mervin Kelly** initiated a new unified solid-state programme in June 1945, as soon as the men who had been assigned to military work began to return to the lab's new 'Idea Factory' at Murray Hill. The aim was specifically to devise an alternative to thermionic valve telephone amplifiers and the initial funding of $417,000 was billed to AT&T.

As manager of the programme, Kelly appointed **William Shockley**, a London-born physicist who had been engaged on anti-submarine warfare research during WW2. When he learned of Ohl's discovery, Shockley immediately postulated that it might be possible to make a solid-state amplifier by applying an electric field across a p-n junction but, initially, all attempts to vary the conductivity with the control field failed. Without any tools to see what was happening inside the crystals at the subatomic level, progress was dependent on intuition and trial-and-error. By January 1946 the group admitted that they were *"groping in the dark"*.

However, the failures led Bardeen to postulate a theory of surface states in semiconductors and to continue experimentation. By late 1947, Bardeen and Brattain had switched from silicon to n-type germanium and felt that they were getting close to success. Then Brattain tried a configuration in which a pair of very closely spaced point contacts were created by using a razor blade to cut a minute gap in the gold foil wrapped around the edges of a small triangle of plastic. The contacts were pressed into the surface of the germanium by a spring fashioned from a paper clip. By December 16th the team had achieved significant power gain and on December 23rd they demonstrated speech amplification to Bell Labs management. An *"entirely new thing in the world"* had been created.

Patenting

Everyone at Bell Labs was familiar with the legend that their company originated because **Alexander Bell** had beaten **Elisha Gray** in a race to the patent office. So, the transistor invention was classified as Bell Labs Confidential until it was better understood and patent protection had been applied for. But in whose name? Shockley was Bardeen and Brattain's supervisor, and was disgruntled that his subordinates had made the breakthrough without his active participation. Bell Labs' lawyers advised that Shockley's own work was overshadowed by that of **Lilienfeld**, and that Bardeen and Brattain were the actual inventors. Consequently, they refused to put his name on the patent for the point-contact transistor.

Professional jealousy and bruised ego spurred Shockley into a frenzy of independent work, which he initially kept secret from the rest of the group, thus starting to alienate them. By the end of January 1948 he had come up with a theoretical transistor design that worked quite differently from that of Bardeen and Brattain, being composed of a sandwich of p-type germanium between two

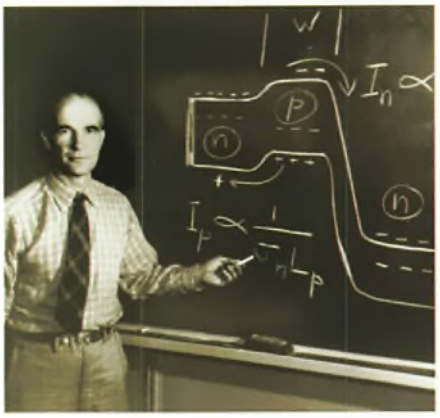
n-type regions. After it was discovered that minority carriers could indeed traverse the bulk semiconductor, the concept appeared feasible and he successfully patented this bipolar 'junction transistor' in his own name. It would eventually supersede the point-contact type but at the time no-one knew how such a device could be fabricated and it was dubbed a 'persistor' because it seemed that much persistence would be required to make it.

Meanwhile, with patent protection secured and after Naval Research Laboratory staff had withdrawn a claim that they had already made the same thing, Bell Labs announced the invention of the point-contact transistor at a press conference on June 30th 1948. Research Director **Ralph Bown** illustrated the structure of the new device with a giant cutaway model. The attendees were given headphones to hear the device amplify and oscillate and to listen to a broadcast received on a radio set that used transistors instead of valves. After the unveiling, the public showed only lukewarm interest but Bell Labs was besieged by requests for sample devices from the electronics industry and the armed forces. By the summer of 1949 the lab had fabricated 4000 working germanium transistors.

Also in that year, the US Justice Department filed a new antitrust suit against the Bell System. In view of this, as soon as the military agreed in late 1951 that transistor technology need not be classified, AT&T made manufacturing licences available without restriction to interested companies in NATO countries and Japan for the relatively modest fee of $25,000 (about $260,000 in today's money). Licensees, government labs and university researchers were given sample transistors. They were also invited to a technology symposium and a two-day transistor manufacturing plant tour at Western Electric that was attended by 100 representatives from 40 companies, including BTH, Ericsson, GEC, Philips, Siemens and Telefunken from Europe. When published in book form, a revised edition of the symposium proceedings called *Transistor Technology* was soon dubbed *Ma Bell's Cookbook*. In 1955 AT&T relinquished its original transistor patents to stave off forced divestiture, although Western Electric hung on to those covering key manufacturing processes.

In the UK, Mullard started production of the point-contact OC50 and OC51 in 1952, before launching a range of junction transistors the following year. Subsequently, over ten British manufacturers produced hundreds of transistor types for different

William Pfann (left) with an early zone refining furnace. (Bell Labs)



Shockley describes the concept of the npn junction transistor. (Bell Labs)

applications, including CV versions for military use. Mullard's *Reference Manual of Transistor Circuits* provided a useful starting guide for many amateur designers but high frequency transistors were still rare and the only transmitter described was a 5-transistor unit for the emergency frequency of 500kHz.

Crystals

While the first point-contact transistors used polycrystalline germanium, the key to the manufacture of junction transistors is the production of extremely pure single crystals that can be doped very precisely with p-type and n-type impurities. Chance often plays a vital role in discovery. In 1915, the Polish chemist **Jan Czochralski** absent-mindedly dipped his pen into a crucible of molten tin instead of his inkwell. When he lifted the pen, he found that it drew out a filament of tin that proved to be a single crystal.

Bell Labs chemical engineer **Gordon Teal** advocated developing this technique for growing large single crystals by drawing a seed slowly from a crucible of molten germanium but he received no support from Shockley or management for this work. Working evenings and weekends, he pursued the idea unofficially, shutting his apparatus away in storage during the day since there was no room for it in the metallurgy lab. By late 1949 he was able to make very pure single germanium crystals and the huge improvement compared with polycrystalline material became evident to all. For the production of wafers for modern VLSI microcircuits, the Czochralski/Teal process is still the basis of the principal method of growing silicon boules, which today may be up to 2m long and 450mm in diameter.

At the same time, **William Pfann** invented the zone-refining method of purifying a crystal ingot by using induction heating coils to displace a small molten region slowly along its length. This causes the impurities to be swept to the end of the crystal, which is eventually cut off. For silicon crystals, a variation of this technique called float zone-refining was devised in which contamination is avoided by maintaining the molten portion in place by surface tension, without a containment vessel. A similar process was also developed independently by Siemens in West Germany.

To produce the npn or pnp sandwich of Shockley's junction transistor, **Morgan Sparks** invented a double-doping method of changing the relative impurity concentrations while the crystal was being drawn from the melt, producing the first grown-junction germanium transistor in April 1950. After further refinement, Bell Labs announced this invention in July 1951. Meanwhile, the trio that had made the initial invention had broken up. Frustrated by Shockley's management style, Brattain refused to work with him again, while Bardeen left Bell Labs altogether. This was a foretaste of the problems that would later lead to the downfall of Shockley's business enterprise.

Silicon

For transistor manufacture, silicon has inherent advantages over germanium because of its greater abundance, lower leakage current and higher operating temperature range. But the material is more difficult to purify and process and, owing to the lower charge carrier mobility, a silicon transistor must have a much narrower base region for high frequency operation. It wasn't until 1961 that, with gold doping and epitaxy, a silicon transistor (the 2N709) exceeded germanium speed.

During WW2 great strides had been made in the art of purifying the material, and by 1945 silicon of 99.999% purity was available.

Gordon Teal (left) and Morgan Sparks developed the crystal growing and doping technologies that made the junction transistor possible. (Bell Labs)

The first germanium junction transistor was fabricated by Morgan Sparks in 1950. (Bell Labs)

Further improvements by DuPont allowed the first grown-junction silicon transistor to be fabricated at Bell Labs in January 1954 but in spite of this success the development wasn't followed up commercially by Western Electric, the manufacturing side of AT&T.

Meanwhile Teal had left Bell Labs to join a fledgling start-up company that would become called Texas Instruments. After telling Teal repeatedly *"This business is not for you. We don't think you can do it"*, Bell Labs finally agreed to accord a licence to TI in 1952. But instead of making only germanium transistors Teal established a group to work on grown-junction silicon transistors and 150 good ones had been made by the time of the IRE National Conference in May 1954. At the conference, speaker after speaker reported that the development of the silicon transistor would take several years so that Teal created a sensation when he revealed that he had a handful of them in his pocket and that commercial production at TI was beginning immediately. With no effective competition,

In 1954 the 4-transistor Regency TR-1 was the world's first commercial transistor radio. Over 100,000 sets were made. (Joe Haupt)

TI then dominated the market for silicon transistors for several years. The little company was suddenly in the big league.

In the UK, the TRE electronics engineer **Geoffrey Dummer**, a specialist in radar synthetic trainers, presented a fundamental paper in 1952 describing the concept of the integrated circuit. But British semiconductor manufacturers were unwilling to take the risk of investing in the idea and it would be six years before radio engineer **Jack Kilby (W9GTY)** of TI was awarded a patent for the first crude IC. He demonstrated that transistors, diodes, resistors and capacitors could be fabricated in a single chip, although his hybrid design required them to be interconnected by flying bonding wires. Bell Labs researchers also missed the integrated circuit and Western Electric had to enter cross-licensing agreements to make them.

Consumer Radio

In addition to hearing aids, it seemed natural that portable radio receivers would be among the first commercially made consumer products to employ transistors. Demonstration sets were shown at the 1952 Components Exhibition in Paris and at the 1953 Dusseldorf Radio Fair, where the Intermetall Corporation that had been founded by Mataré on his return to Germany demonstrated a prototype receiver that used four hand-assembled point-contact transistors.

But the established radio manufacturers were initially reluctant to change over from thermionic valves, which were cheaper than transistors at the time. So, in October 1954 Texas Instruments and Industrial Development Engineering Associates (IDEA) in Indianapolis teamed up to launch the famous $49.95 Regency TR-1. This pocket-sized MW AM set used four npn germanium junction transistors in a superhet circuit with one local oscillator/mixer, two 262kHz IF stages and one audio amplifier. (The low IF was chosen to increase the gain). Before teenagers adopted it as a personal music player, the radio was marketed as a 'security item' since the USSR was now an atomic power. In spite of its somewhat mediocre performance, the radio was a success and almost 100,000 sets were sold in the first 12 months. But having underestimated the cost of making the radio, TI hardly broke even on the venture and after that the company concentrated on making semiconductors for other manufacturers to incorporate in their products.

One of the enterprises that emulated the TR-1 was a small Japanese company called Tokyo Tsushin Kogyo (Totsuko). With little more information than a Bell Lab's licence and *Ma Bell's Cookbook*, they started manufacturing point-contact and then junction transistors, obtaining a reasonable yield of about 5%. After a false start with a portable radio whose plastic case was found to come apart in the summer heat, they launched their TR-55 model in August 1955. This 5-transistor set was Japan's first transistor radio and it spearheaded the entire Japanese consumer electronics industry. For the product launch, Totsuko's owners changed their tongue-twisting brand name to one that could more easily be pronounced in the West. They called it Sony. The name became well known outside Japan after discerning thieves who broke into a New York warehouse ignored other makes to steal only the 4000 Sony radios stored there.

In 1953 Philco developed electrolytically machined surface-barrier germanium transistors that could operate up to 60MHz and manufacturing licences were granted to other companies including Sprague and a division of Plessey. In 1955 these transistors were used in the first commercial transistor car radio and in 1958 improved versions were orbited in the 108MHz beacon transmitter carried by Explorer 1, the first US satellite.

Next month I will conclude by describing the first uses of transistors in amateur radio and more recent developments in transistor technology.

World of VHF with Tim Kirby G4VXE
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• E-mail: tim@g4vxe.com • Twitter: g4vxe

New Region 1 144MHz DX Records

Tim Kirby G4VXE has news of some impressive DX worked on the 2m band.

It's always interesting and inspiring to be able to report on new DX records and this month, there are two! On August 5th, **Mark Turner EI3KD** worked D4Z on the Cape Verde Islands on 144MHz over a distance of 4163km, which stretched the record by about 30km. For those that think all DX is worked on FT8, you'll be delighted to know that this was a CW contact. On SSB, **Tim G4LOH** also worked D4Z along with **Dave G7RAU**, both in Cornwall. The conditions had been up and down for quite some time with the D4 beacon being heard from Cornwall to Northern Ireland and Scotland where GM4ZJI logged it at a distance of 4739km. The D4 beacon runs a modest 14W into a stacked dipole array.

The path was also open from the western UK to the Canary Islands (EA8) with some excellent contacts being made. **Tim Hague M0AFJ** (Helston) reported working more than ten EA8 stations on 2m SSB. **Richard Brooks GW1JFV** (Haverfordwest) was delighted to work EA8 on FT8, using 50W to a vertical antenna. **Jim Edgar GM4FVM** (Alnmouth) also worked EA8 although, as he says, it nearly didn't happen. Jim's rotator was 180° out of synch and he wondered why he couldn't hear anything at all from the DX. Once that had been established, Jim says it was all straightforward. All in all, it was an incredible few hours!

The sea path to EA8 and D4 from the western UK is a fascinating one and would probably support the higher bands as well. As **John Worsnop G4BAO** said on Twitter, *"a 23cm QSO from North Cornwall or Ireland to D4 would break the world record on the band"*. That would be very exciting indeed.

The following day on August 6th, Dieter DJ6AG worked EA8TX, breaking the Region 1 144MHz meteor scatter record over a distance of 3428km. This exceeds the previous record held by EA8TJ and S50C by 51km. In reality this was very probably a combination of tropospheric and meteor scatter propagation but a truly remarkable contact in itself.

Remote Operation – an Update on Teamviewer

I mentioned in a recent column that my usual program for remotely operating my station, Teamviewer, had stopped working, citing that I was using the program commercially, which is not under the terms of the licence. I wrote to the software vendor explaining the situation and after some weeks, I had an e-mail back saying that they had looked into the circumstances and they had reinstated my free licence. I mentioned this to **Peter Taylor G8BCG** who I knew had also experienced the problem and he said that the same had happened to him. So, if you got the same message, it will be worth writing to Teamviewer support and explaining your situation – hopefully you will be back on line in due course.

Transatlantic Reception on 88MHz

Although the remit of *PW* is amateur bands and this item concerns reception on the Band II broadcast band, I feel it will be of great interest to those of us who have an eye on possible 70 and 144MHz contacts across the Atlantic. On July 8th, **Paul Logan** in Lisnaskea, Fermanagh, Northern Ireland managed to catch CBC Radio 1 from Newfoundland, Canada on 88.5MHz at 2135UTC.

Paul was using a 5-element beam and an SDR receiver. You can see a video of the reception on the EI7GL blog (which is well worth a read anyway) at: **https://tinyurl.com/y7rkq7d7**

Paul has a website of his own too, which is of interest but looks as if it may not have been updated in a while: **https://band2dx.webs.com**

Paul's reception is a great encouragement for those looking at a 70MHz path and indeed for a 144MHz path but as students of Es know, there is a world of difference between Band II being open and the 2m amateur band being open – particularly for multi-hop propagation.

The 6m Band

John Wood G3YQC (Hereford) just missed the last deadline but had worked lots of interesting 6m (50MHz) DX during June, mainly on FT8. John had noticed a number of stations generally from Spain working or calling Japan. John didn't hear any Japanese stations although he did see one BF (China) and one VU (India) briefly but not for long enough to attempt a QSO. The month got off to a good start with 9K2HS on June 10th and a good opening on the 12th when John worked FM5AN, HI3T, WP4JCF and HI8PLE. On June 14th John worked 5T2AI and PZ5RA and then the following days included ZF1EJ, VP5DR, VP9NM, CO8LY and VO1SO, with SU1SK worked on June 18th. John heard a station signing ZL2IFB on June 18th at around 1015. Was it **Gary**? It would be pretty remarkable if it was! On June 24th, John worked five Icelandic stations. John says for the rest of the period through to July 7th he worked a steady stream of DX, much of which was in Central America.

John found July a little less lively but nevertheless found some nice ones: July 7th, A71EM; July 8th TF3JB and WP4G. On July 21st, John heard SP9HPA working VK8AW but could hear nothing from the VK. VK8AW was also being called by some UK stations on July 24th. On July 23rd, John worked CT3HY, which was a new country for him as was HB0WR on the 24th. On July 30th there was a nice Caribbean opening with WP4G, FG8OJ,

HI8PLE and KP4EIT along with a good number of US stations. As John says, don't assume the season is ending yet – you will be sure to miss some good DX. John is up to 85 countries worked on 6m FT8 and the best distance in July was K5RK at 7624km.

Dave Hobro G4IDF (Worcester) says that the start of July was good for Es openings. On July 6th, Dave worked OE6END (JN77), UW8SM (KN28), OK2DIK (JN99), HA4FB (JN96), DG0DRF (JO71), HG60KCI (KN06), DG3RAP (JN69) and OK1ICQ (JN79), all on SSB.

Jef Van Raepenbusch ON8NT (Aalter) operated a mix of SSB, CW and FT8 contacts during the month, with the highlights being July 6th Z68M (KN02) and 9H1TX (JM75) on CW; July 7th C31CT (JN02) on CW; July 12th LX1JX (JO30) on FT8; July 15th EA8CNR (IL28) and EA9ABC (IM75) on FT8; July 18th EA8ACW (IL28), EA8JK (IL18), ZB2GI (IM76) on FT8. July 21st TF3JB (HP94) on FT8; July 22nd CN8KD (IM63) on CW, EI5HV (IO51), EJ0DXG (IO42), EA8DBM (IL18), EA9ACR (IM75) on FT8; July 23rd VE1PZ (FN85), EI7IX (IO53), 9K2HS (LL39) all on FT8 – wow, nice one Jef!. Jef runs 10W to a V2000 vertical.

Kevin Hewitt ZB2GI (Gibraltar) is another one with some remarkable contacts from a simple setup. Kev runs a Yaesu FT-450 and a dipole. The highlights of his FT8 operating during the month are 5A1AL (JM62), ZF1EJ (EK99), T77C (JN63), C37MS (JN02), WB4HIE (EM95), K4PI (EM73), WB4YDM (EM84), K4OY (EM74), AA4SC (DM13), K9RX (EM84) and R6KA (KN75) along with plenty of East Coast USA and European stations. On SSB, Kev worked EA2IA, G3SVD, EA1BUB, F6EZV, F8GQO, EA1DHB and F5SRH. Operating as ZB2GI/P from the top of Signal Hill, Kev worked a good number of European stations on SSB with the highlights being GM8IEM (IO78) and EA8DBM (IL18).

Roger Lapthorn G3XBM (Cambridgeshire) writes a very welcome e-mail and says, "*Like quite a few, I am trying 6m FT8 this season to see how it compares with 6m JT65. Although I have quite a small station, results have been encouraging. I use a V2000 vertical fed with CB coax yet have spotted USA, Canada, Caribbean, South America, Africa, Israel and the Gulf. Last year I spotted Japan several times on 6m JT65 but no luck this Es season on 6m FT8. Although FT8 is pretty good, the few dBs down on JT65 is noticeable on my small station. Most times I am on 6m FT8 receive, although I have had several spots from southern Europe on 6m FT8 when using my usual 2.5W QRP*".

Fig. 1: Icom collectors' heaven! The corner of Robert PA9RZ's shack with an IC-502 (6m), IC-215 (2m FM), IC-202 (2m), IC-3L (70cm linear) and IC-402 (70cm).

Mark Marment CT1FJC sent me a log with all his contacts over 2500km – and there are still a lot of them! So, the highlights of the highlights are: July 6th K5XI (DM43); July 16th W5ADD (EM40); July 17th EK7DX (LN20) and July 20th K5QE (EM31). W0FK (EM48) gave Mark square 954. On July 19th, Mark heard BH4IGO for one period but never copied him again. Mark had tried to work several JAs but without success. One of the loudest was JH6VXP (PM53).

Derek Brown G8ECI (Louth) says he has been picking off new squares and countries on FT8 when he is in the shack (which has been like an oven!). Derek says some of the openings have been a bit frustrating, seeing what Europeans and stations further south and west from him are working, but even so Derek managed some contacts into Georgia and Florida. Derek says that the level of activity has been amazing and imagines what it will be like if the F2 conditions get back to the 1988/1989 levels.

Phil Oakley G0BVD (Great Torrington) got on the band during the UK Activity Contest, working EI9E/P, G3TXF and G3WAG/P.

Peter Taylor G8BCG (Liskeard) says the main focus this month has been 50MHz Es. Peter says he was particularly pleased to get Thailand in the log on the only weekend in the year that they are allowed on the band. He says that this year he heard many Thai stations, mostly on FT8 but also on CW. Peter worked HS3LSE and HS5LYK. The contact with HS3LSE (OK14) was Peter's best terrestrial distance on the band for the year so far at 9960km, just pipping OA4TT who is 9957km. During 2018, Peter has worked 111 countries as at July 31st, including 101 on FT8! Looking at QSOs by mode in the year is interesting too: CW 11, SSB 164, JT65A 6, JT6M 4, FT8 1738 (including 726 from the US).

The 4m Band

On the 4m (70MHz) band Jef ON8NT runs 10W to a halo antenna on his balcony. During the VHF NFD weekend he worked a number of stations with the best being G2LO/P (IO92), G3SVJ/P (IO91) and the most distant G4RFR/P (IO80) at 415km. Jef found G4SGX, G3SHK and G4FUF on FT8.

Mark CT1FJC reports some success on FT8 getting people to QSY (move frequency) to a part of the band that CTs are able to use. Mark worked: July 7th G0CHE (IO90), G4FUF (JO01); July 17th DJ5MN (JN58), G3SHK, DK5EW (JN48), G3YDY (JO01), EA8DBM (IL18) and DN5JD and on August 7th, GD0TEP (IO74).

I managed to give the wrong details for Derek G8ECI's 70MHz station in the last column – sorry Derek. Derek is using an IC-756 to a G3WPO transverter that drives a 4CX250B amplifier.

Robert van der Zaal PA9RZ, Fig. 1, was active during the Field Day weekend on July 7th and 8th and says that in the Netherlands it's not a dedicated Field Day contest. Robert worked G0FBB/P, G0VHF/P and G5LK/P, all in JO01, which were easy for him to work running 10W from the IC-7300 into his log periodic.

The 2m Band

On the 2m (144MHz) band, **Dave M0TAZ** operated with the Suffolk RED field weekend on July 14th and 15th, **Fig. 2**. The idea was to try something new. Dave decided to try to work as many European stations as possible on both phone and FT8. With a good take-off into Europe, Dave was soon working into France, Germany, Denmark and Belgium. He says that over the course of the weekend, he completed 50 contacts in 25 squares. Some of the highlights were DL3GAK at 662km, F4VYH (673km), OZ-1BEF (693km) and OZ1BP (698km).

Jef ON8NT had a good time during the UK Activity Contest (UKAC) on July 3rd, with the highlights being G0EHV/P (IO84), G8PNN/P (IO95), G4KUX (IO94), G8DMU/P (IO94), G8KPD/P (IO85) and G8SFI/P ((IO94). During the VHF Field Day weekend, the highlights were GW3ZTT/P (IO82) and DK0FW (JO51).

Simon Evans G6AHX (Twyning, Gloucestershire) says that his house has been full of visitors so there has been limited time for radio. However, during

the UKAC on August 8th, Simon made 26 contacts in 15 squares, with the best DX being GI4SNA (IO64). On August 5th, Simon says he had a really enjoyable contact with **Keith GU6EFB** with 59 reports both ways. Simon also says that he would like to welcome Lyn, now G8JLY to the Midlands having moved from Cardiff.

During the course of an e-mail conversation about (unexpectedly good) 2m FT8 results on verticals, Roger G3XBM said, "*Quite a while back someone local suggested I compare 2m FT8 on the big-wheel horizontal omni and the V2000 vertical omni. There was very little difference, suggesting that polarisation was not important, so probably aircraft reflections*". If you haven't tried FT8 on 2m and you are holding off because you don't have a beam but have a vertical, for example, give it a go. I think you will be surprised at what you can hear and work!

Robert PA9RZ operated during the VHF Field Day weekend and made some nice contacts, including M0NFD/P (IO94), and says it was good to hear a northern accent again. Other highlights were OZ1ALS (JO44), DA0FF (JO40), GW3SRT/P IO82) – on CW. Robert was using his IC-202 to a 5-element Yagi.

Roger Daniel G4RUW (Newbury) says that the Es season has been a bit hit and miss for him but made a couple of contacts: June 9th YU1EV (KN04) and June 11th CT1CAD (IM67) and then nothing until July 27th when he worked SV8PEX for a new country and square. On August 9th, Roger listened during the D4 opening and heard some brief CW a couple of times, which sounded typical of meteor bursts. Roger is pleased with his new 8-element LFA Yagi.

It was great to hear from **Lyn Leach G8JLY** (Droitwich). I'd seen Lyn on FT8 recently so I knew he'd wasted no time in getting active. Lyn says of his new location, "*I am now QRV again from my new QTH in IO82WG, Droitwich Spa, Worcestershire but with a much smaller setup than I used at my previous QTH in Cardiff. The good thing though is that this seems to be a very good QTH for VHF and up. In this new location I am using just a small 6-element Yagi with a 1.7m boom at only 25ft above ground level mounted on the north-facing wall of my house. I have noticed that signals via tropo from all directions are much stronger than those I would have received at my Cardiff location. My take-off to the north and north-east is particularly good and it's now very easy to work stations in those directions. I am an avid locator and countries chaser on the 2m band and have been busy working as many new locators and countries as I can from here using both SSB tropo and meteor scatter. In just a week or two, I have worked 48 new locators and 14 new countries, with these totals increasing daily*".

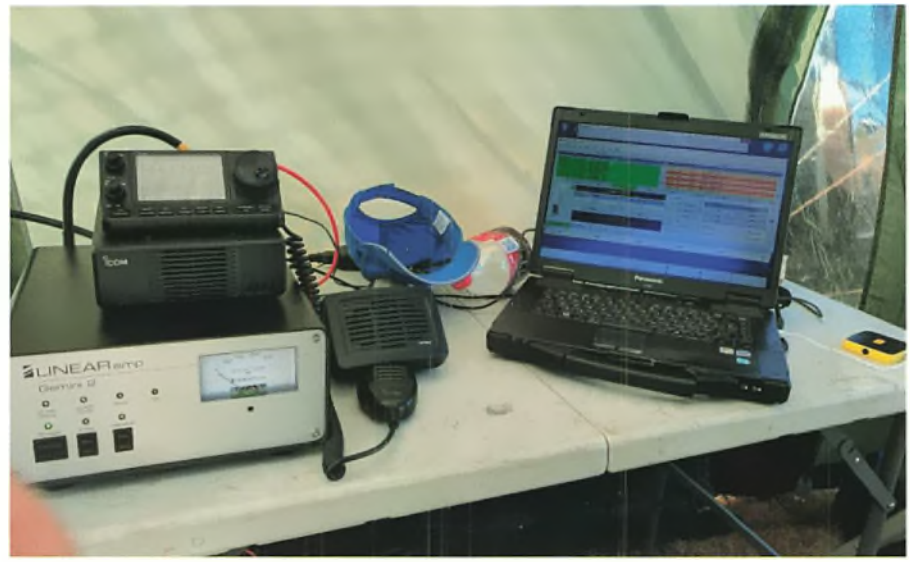

Fig. 2: M0TAZ/P operating from Suffolk had a good weekend on 2m FT8.

The 70cm Band

Highlights for Jef ON8NT on the 70cm (432MHz) band were G4CLA (IO92) and G4ODA (IO92) during the VHF Field Day weekend. Robert PA9RZ made several contacts over 400km, including M0NFD/P, DA0FF, OZ1ALS and M0HRF/P (IO91). Robert was running his IC-402 and IC-30L linear with a 12-element Yagi.

The 23cm Band

On the 23cm (1296MHz) band Robert PA9RZ worked a number of Gs, PA, DL and ONs during VHF Field Day with the best DX being G0OLE/P. Robert was running around 8W from his IC-910 to a 21-element Yagi.

Satellites

Jef ON8NT monitored the ARISS contact from the International Space Station to a school in Bonn, Germany on July 3rd. On July 18th, sitting on his balcony, he received SSTV signals on his ID-51 and rubber-duck antenna although signals were too weak to give high quality pictures. On July 30th and 31st, Jef received nice signals from the ARISS Russia MAI SSTV experiment using his Icom ID-51 and a 5-element LPDA.

Kevin ZB2GI, operating as ZB2RAF worked EA8TJ, G4BXD, G0IIQ, MI6GTY and EB5YF through AO-91. Kev writes of the SSTV activity on July 30th/31st, "*I received nine full images with four duplicates and two partial images during four passes varying from 16° to 41°. My setup comprised a Yaesu FT-817 connected via a data interface to a Win7 Notebook PC running MMSSTV and a manually tracked 2m/70cm Log Periodic, ISS Detector Pro, an Android App, provided pass predictions and the azimuth/elevation to point the Log Periodic*".

Patrick Stoddard WD9EWK (Phoenix) writes, "*Lots of stations going all over the US and Canada working satellites this summer. It has been a good time to work rare grid locators. I did my part just after the Independence Day holiday in early July, when I drove to southern California for a few days. I put five different grids on the air during that drive, including one grid using AO-92's L/V mode.*

"*Sad news from over here this week, with the passing of* ***Bill Tynan W3XO****. Bill was a founding member of AMSAT, served as a member of AMSAT's Board of Directors as well as its President and, in the 1980s, was the editor of the* World Above 50 MHz *column in* QST. *It was in that column that Bill lobbied for use of the Maidenhead grid-locator system in North America, once it started being used in Europe. This was followed by ARRL creating the VUCC awards for VHF/UHF and satellite operating*".

It's been a very busy column this month. Thanks to everyone who has been in touch. There's always room for more though. If you have been thinking about getting in touch and haven't done so yet, please do – it would be great to hear from you.

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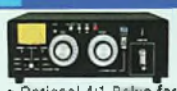

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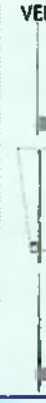

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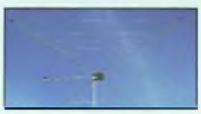

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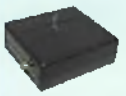

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The Onset of Autumn

Steve Telenius-Lowe PJ4DX reports on a heady combination of special event station activity, summer propagation and plenty of interest in FT8.

Propagation usually improves around the autumn equinox and DXpedition organisers are keen to take advantage of this. If last year is anything to go by, there will be many DX operations taking place from mid-September and in October but I would like to highlight three:

Seven Czech operators have announced they will be active from Mayotte (AF-027) in the Indian Ocean from September 21st to October 5th. The callsign will be TO6OK, a special prefix rather than the usual FH. They will run several stations with linear amplifiers and HF beams, directional vertical arrays on 30m and 40m, and verticals on 80 and 160m. www.cdxp.cz

The Italian DXpedition Team will be active from Rwanda as 9X0T (and as 9X0Y when using the FT8 DXpedition mode) between September 26th and October 10th. www.i2ysb.com/idt

Later in October another rare DXCC entity and IOTA island will be activated: Ducie Island (OC-182). **Fig. 1**. Politically part of the Pitcairn Islands but a separate DXCC entity by reason of its distance (540km) from the main Pitcairn Island, Ducie has only ever been activated three times: in 2002, 2003 and by the VP6DX DXpedition in 2008. VP6DX made the then record number of 183,584 QSOs, only surpassed by the UK-led T32C DXpedition to Christmas Island in 2011. VP6D should be active from October 20th until November 3rd. Despite being in the South Pacific, Ducie is a somewhat easier path from the UK than Baker Island, which was activated by KH1/KH7Z in June – July (see last month's *HFH*). https://vp6d.com

Fig. 1: One of the idyllic beaches on Ducie Island.

Club Activities

In July the Hartlepool Amateur Radio Club had a club evening operating on 10m. Regular *HFH* contributor **Carl Gorse 2E0HPI** said that *"taking advantage of the Sporadic E conditions on July 6th, three members of the club, **Tom M6TJI, Stan G7VGM** and Carl between them worked 23 stations in just under one hour."* Using the club call MX0IDZ and running a Kenwood TS-870 with 80W to a vertical antenna at 10m supported by a tilt-over mast on a drive-on base in the club car park, the trio made contacts with German, Swiss, Italian, Czech, Belgian, Dutch and Polish stations. *"No real DX but a great pleasure to work the pile-up and nice to chat with all stations contacted"*, Carl concluded.

Ed Spicer M0MNG of the Amberley Radio Group sent in a report on the GB2CPM operation at Amberley Museum during the International Museums Weekend (IMW), **Fig. 2**. *"We made 120 contacts altogether, of which 18 were with other registered museums. This is not a bad percentage considering that just under 70 museums had registered on the IMW website,"* Ed said. *"40m SSB was the band and mode of choice, with just a handful of QSOs on 20m and even one on 12m. All our contacts were inside Europe and the majority of those were inter-G. I had feared there would be little or no inter-G propagation during the museum's opening hours when we were on air, so I was extremely pleased to be wrong... Bearing in mind that we are approaching the bottom of sunspot cycle 24 and the recent poor conditions on HF and 40m in particular, the weekends were a great success for GB2CPM. We will certainly be back for the next IMW in June 2019."* Some museum photos are at: www.qrz.com/db/gb2cpm

Readers' News

Reg Williams G0OOF wrote about his activity in the IOTA contest at the end of July. *"Good to work PJ4DX during the IOTA contest on 20m. You certainly had a pile-up on your hands but handled it with calm expertise. I noticed that your signal was much stronger in the later evening. I worked quite a few European stations on that band after midnight local time. I enjoyed the contest even more this year, now that I am able to work all bands. It was good to spend some time on 40 and 80m, which gave a reasonable idea how well the 6-band vertical was working, as well as the higher frequencies. Most island stations worked were European but I managed a few contacts to North and South America... I have concentrated mainly on the lower HF bands in the month, trying out the 6-band vertical. There was a good opening into Europe on 15m, strangely on the 15th of the month."*

Fig. 2: Keith Smart 2E0KCB sitting in the 'hot seat' at GB2CPM. Fig. 3: G4HZW's antennas: Wellbrook loop, 4-element Sirio 10m Yagi on a Tennamast and, on top, a 3-band collinear. In the foreground, the Usher's Clematis montana.

Etienne Vrebos OS8D and ON8DN reports *"Very poor HF radio activities this month... I participated on Saturday July 28th in the IOTA contest but no special IOTAs, mostly Europeans. We got very hot weeks here with over 38°C! Exceptional, and I really don't like that heat. Today it's the first day below 30°C."*

Terry Martin M0CLH says, *"Quite a few in the log again but nothing too spectacular as the summer doldrums and lack of sunspots conspire against us. At least some Sporadic E has kept the upper bands alive with a few slots filled. The drought here in England has probably not helped either, resulting in a poorer ground plane for my vertical!"*

Victor Brand G3JNB described July as an *"Interesting month: despite SFI* [the Solar Flux Index] *bottoming out at 66, there were spasms of useful activity on CW on the DX bands, particularly for the IARU and IOTA contests. It is always interesting to hear stuff on an apparently empty band, especially just before bed. It has been most noticeable on the Cluster that FT8 has dominated the postings, together with 6m calls. SSB about normal but CW posts at a new low!"* Last month in this column I wondered if anyone in the UK would report the Baker Island DXpedition in July and Victor commented: *"With the SFI down at 67 and the short or long paths to Baker Island passing over the poles, hearing KH1/KH7Z was always going to be difficult. Following the reliable propagation forecasts for members by the Norfolk ARC's specialist,* **Steve G0KYA**, *I did copy them on 20m CW mid-morning on the 2nd and 4th. Very weak and, realistically, not workable here with 50W. Still, it was good to actually hear them!"* One evening **Mike GM0HCQ/MM**, aboard the survey ship *RSS James Clerk Ross*, was logged from 81°N 29°E (turn right, above Svalbard Island in the Arctic). On the 13th, Victor enjoyed one of those contacts that he says *"can still generate the thrill of DXing. Checking a very quiet 20m just before bed, I noticed a posting on the Cluster for HI/KG4ZXN. The signal was right down at 'ESP' level but on peaks was heard calling CQ with only an occasional response from EU. It took me ages to attract his attention when small peaks in the QSB permitted but, eventually, I made it. Immediately, I went to QRZ.COM and saw that Bill was on holiday in the Dominican Republic and running an FT-857D with 100W to just a mere 57ft length of wire hanging out of his window! Then, scrolling down the page, I realised that he had a live feed from his log, via Club Log, to his QRZ page. The call G3JNB was showing already, just a couple of minutes after we had signed! That was a new experience for me, my fastest ever DX confirmation."*

Tony Usher G4HZW is now up to 108 DXCC entities worked and 83 confirmed by Logbook of The World (LoTW) on 10m FT8 since starting to use that mode in September 2017. He wrote *"I've not done as much operating in July, mainly due to the temperature in the shack – the house is well insulated with triple glazing so once the heat gets in it's reluctant to leave!"* Tony sent in a photo of his antennas against a cloudless blue sky, **Fig. 3.** This month he mainly worked Europeans as the excellent Sporadic E season continued; the DX stations worked are listed in the band reports.

This month's HF Highlights for **Kevin Hewitt ZB2GI** included activating ZB2RAF: the Royal Air Force celebrated 100 years and 100 days on July 10th and Kevin made 100 FT8 contacts, 10 contacts on 10 bands, to commemorate the centenary.

Martin Evans GW4TPG thought the bands *"fairly flat, not much in the way of contests (I missed IOTA at the weekend) or DXpeditions to work. Not one CW or SSB QSO for the whole month. Looking back, the last time I went a whole month without at least one SSB or CW QSO was 2007, which is probably a good indication of where we are with solar cycle 24. Saying that, there is still DX around on FT8. This month I have concentrated most of my operating time on 12m, looking both for new DXCC entities to work and previously worked DXCC entities but with no LoTW QSL... I managed to get the magic 100 confirmed on 12m on July 30th with SV9AHZ worked and confirmed via LoTW the same day. I managed to work ten new ones on 12m in July leaving me just 80m to go for 8-band DXCC. I did manage to work one new one on 80m too (4L1FL), thanks to a bout of insomnia one night... Looking forward to autumn and some decent CW and SSB operating again."*

Carl 2E0HPI wrote, *"I have been concentrating on the 10m band and have been operating portable at different locations in the north of the UK. The antenna was a Hawkins SSD-58 on a 10m pole, which worked quite well when we had openings. So far, I have worked from Captain Cook's Monument 328m ASL and Harthorpe Moss in the North Pennines at 630m ASL (GFF-0264)* [**Fig. 4**]. *I have also been using the Alex Loop in the garden at home running 10W in the IARU Contest."*

During the IARU contest 2E0HPI worked

Y82D. A total of 63 YB callsigns were issued by *BNetzA*, the German licensing authority, for competitors at the World Radiosport Team Championship that ran concurrently with the IARU event. Readers of a certain age and with long memories will recall that the ITU callsign block Y2A – Y9Z was formerly used by the German Democratic Republic (East Germany) prior to reunification in 1990, **Fig. 5**.

Band Reports

Reg G0OOF reports the following. 80m SSB: KP4/K6DTT, OZ11A, PA10TA. 40m SSB: A41CK, C31CT, CR3DX, EA6AIU/P, EJ0DXG, GD6HX, IC8WIC, MD7C. 20m SSB: 5B4KH, 5Q2J, 9H6A, CR3DX, IM0PNM, MX5A, PJ4DX, VY2TT. 15m SSB: CR3DX, IQ0SS, PJ2Y, VY2TT. 10m SSB: EU1A, CR3DX, IQ3ME/P, IS0BSR, OZ11A.

Etienne OS8D / ON8DN apologises *"for this very poor log, 100 QSOs in total"* yet still worked two All Time New Ones ('ATNOs'): 20m SSB: 3V8CB, 5E5R, AP2BDR (ATNO), C37UN, E20WXA, E51JD (ATNO), EP2LMA, JA8COE, JW100PUT, KW7Y, OX3MC, VY0ERC, VY2TT. 17m SSB: HV5PUL.

Terry M0CLH offers 30m FT8: EJ0DXG. 20m SSB: LM90NRRL, OJ0C. 20m CW: LZ380PM. 20m RTTY: 9A18FWC. 20m FT8: A41ZZ, R9XAC, RN2F, S01WS, TA1BZ/2. 17m CW: GM6XX, PF2018FRA. 17m FT8: 4O7CC, 7Z1IS, A41ZZ, PY2EGM, SV9/G0DLV, T77C, VE1JS, VP8LP. 15m CW: LZ380PM. 15m FT8: 9K2HQ, A41ZZ, K5EK, TF2MSN, ZS6SJR. 12m FT8: EA6SX, KO2E. 10m SSB: G4ELP. 10m FT8: CT3KN, GD4SKA, ZB2ER.

Victor G3JNB worked: 30m CW: 5E5A, C31CT, CU2/OK1DX, HV0A, FY5FY, S01WS, TF/VE2DZ, UA0CGU, ZB2RAF. 20m SSB: PJ4DX. 20m CW: 7X4AN, HD18FIFA, PJ2Y, PJ2/NA2U, XQ6CFX, YV5LAY. 20m PSK31: 9Y4FIFA.

Tony G4HZW used 10m FT8 exclusively to work 9Z4S, BD0AAI, CA2CEV, NP4RA, PJ2MAN, PZ5RA, VP9NM, YV5MBI plus 29 W (all east coast).

Kevin ZB2GI, reported the following: 20m SSB: 9H1JL, CQ918FWC, ER18FIFA, GJ3RCV (EU-099 'Minkies'), OD5ZZ, PV8AL, PY6TV, R18IRN. 20m FT8: A75GD, CX3AL, JH0RNN, OD5ZF, PY2COY, PY2FUL, ZS1ZKZ. 17m FT8: A65DR, TA5FA, JF3UYE (**Fig. 6**) and no fewer than a dozen other JA stations. Also, operating as ZB2RAF, Kevin used 80m FT8 to work: AO3JMT. 60m FT8: LU8HF, N3GAR. 20m SSB: GB100RAF, GB3RS, JH1MDJ, LX1BB, TA7OM and many other Europeans.

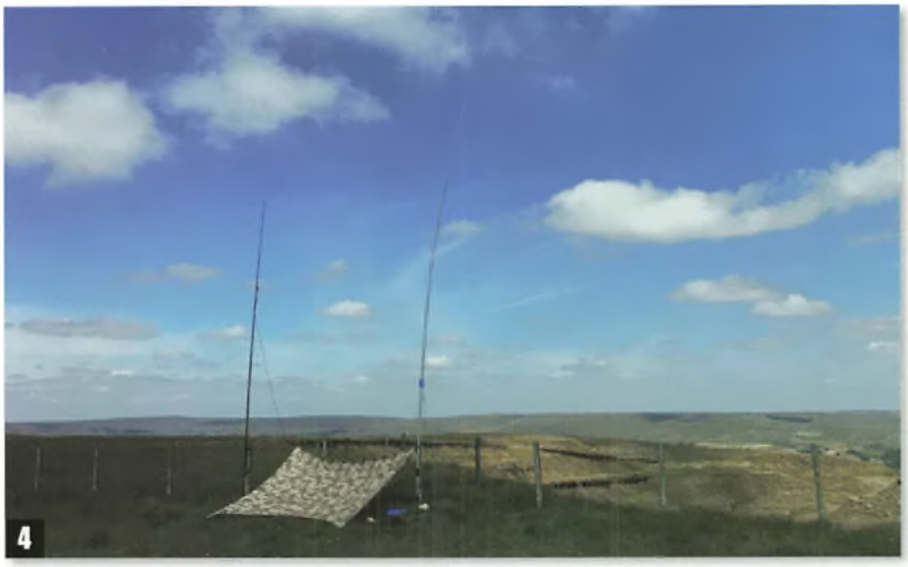
Martin GW4TPG put these in his log: 80m FT8: 4L1FL, CU2DX, VE9MY. 40m FT8: A41ZZ. 30m FT8: BG4QNE, HI8CSS, J35X, SV5DKL. 20m FT8: CE2SQE, CO2II, FK8HE, KP4JRS, JF3VAX, VE9FI, YB0GRF. 17m FT8: 5P6MJ (EU-172), 9H1ET, A61QQ, HL4CJG, PY4OY, VR2XMT, VU2EKJ, VP8LP, ZD7GWM. 15m FT8: BD0AAI. 12m FT8: 4Z4DX, 5B4VL, CE1OEB, CU2AP, EA6VQ, EA8CYL, EW4M, KB8U, LU5HA, SV9AHZ, WB2REM, Z68M, ZD7BG.

From home Carl 2E0HPI worked 20m SSB: CR6K, LX8HQ, OE0HQ, TM0HQ, Y82D. And, as 2E0HPI/P, on 12m SSB: AO18FWC. 10m SSB: 9A4FM, DO1TLR, EA3BLL, F5VIG, OE3WMA, OK1AQW, OM1AX, S57AC.

Finally, a brief note from **Owen Williams G0PHY** listed 20m SSB: J32FIFA, LU1YT, PJ4DX, VY0ERC. 10m SSB: C37UN.

Signing Off

Please send any input for this column to **teleniuslowe@gmail.com** by the first of the month (October 1st for the December issue, November 1st for the January 2019 edition). I would especially welcome photographs for publication in the column. Thanks to all contributors. 73, Steve PJ4DX.



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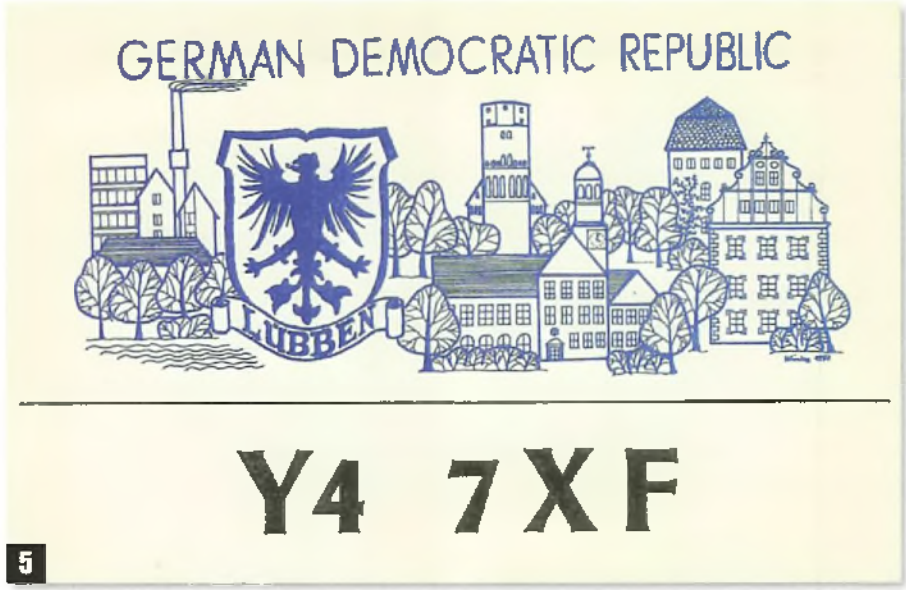

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Fig. 4: 2E0HPI/P operating location at Harthorpe Moss, 630m ASL (GFF-0264), with 10m antenna. Fig. 5: Historic QSL from Bert Y47XF in Lübben, formerly in the GDR, dating from 1981. Fig. 6: eQSL from JF3UYE for an FT8 QSO with Kevin ZB2GI.

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Building Notes for a Direct Conversion Receiver

Andy Choraffa G3PKW takes readers through the design of Direct Conversion receivers using modern components.

In recent years it has become popular to build direct conversion receivers using modern semiconductor devices such as the NE602 Gilbert cell mixer. Also, the 386 audio amplifier chip is a very useful and cheap device and is often used as a further stage of amplification.

Because they are produced in large quantities, these devices are very cheap for their large content of semiconductor devices and their versatility but they need to be understood when used away from their original intended application.

The 602 mixer chip uses an array of semiconductor junctions to act as an RF mixer. It is known as a DBM (Double Balanced Mixer) and it ensures that both the input signal and the oscillator signal are suppressed, leaving only the sum and difference frequencies at the output. DBM designs of IC were developed by people such as **Jones** and others but the 602 is named after its developer **Barrie Gilbert**.

The Gilbert design allows mixing to take place in a way that multiplies the inputs more efficiently as the frequency approaches the circuit's upper limits. Gilbert designed it this way to enable its use at frequencies in the VHF and UHF spectrum for applications in PMR (Private Mobile Radio) designs.

As a consequence, the input and output impedances of this mixer device are lower than the more conventional types of DBM. High volume mass production of this chip allows it to be a very fine, economical mixer IC. HF circuits designed by radio amateurs don't, as such, use the VHF advantages of the Gilbert design but some circuits attempt to use the internal oscillator circuitry.

The 602 oscillator circuit, when employed in PMR designs with a crystal oscillator, uses what is known as an overtone circuit, normally in a series mode configuration, which means that the 602 chip was meant to operate at fairly low impedances. As a concequence, when using this device as a straight DBM at HF, it is not the easiest to use as a self-oscillating tunable mixer arrangement. The stability and, more so, the purity, of the oscillator are essential with a VFO (Variable Frequency Oscillator) in a DC receiver design.

There are many designs that attempt to use the chip's own internals as the oscillator. This appears on the surface to be prudent use of the available device but it is a case of the old saying, 'trying to save the ship for a ha'pe'th of tar'. It is far better to build a separate oscillator using an FET, for instance. This can have much better purity and stability as needed for this type of application. Using an FET oscillator with a minimal amount of feedback in its design, can lead to a much lower harmonic content. This purity of output is extremely important in an HF application such as required for direct conversion because any unwanted frequencies fed to the mixer will allow unwanted input frequencies to be mixed to the audio output. It is vital, therefore, that the local oscillator is producing as clean a sinewave as possible.

I built a VFO around the 602 chip using a standard tuned circuit but found it was not very reliable in starting. I concluded that this was due to those low impedances that the chip was designed for. I also referred to other published designs and they all seem to use small inductance values with large resonating capacities. A sign of low dynamic impedance values.

Further Experimentation

As I experimented, I found an HF crystal in a series mode worked fine, much as the chip was designed for. I could have continued to wrestle with it but its lack of purity encouraged me to build a separate oscillator. The spectral purity of the 602 VFO design was poor. The third harmonic at 21MHz was only about 12dB below the 7MHz output. It also had some second harmonic at 14MHz, at about 25dB down. In a VHF PMR circuit with a crystal this would not have presented any problem.

I therefore built an FET VFO, which started well and with a good clean spectrum. It was very clean with all harmonics at least 40dB down, which I suspect was due to the fact that it was oscillating with minimal feedback. The FET circuit only consumed about 1.4mA with a 4V supply rail and started without any problem.

A Practical Receiver

The accompanying circuit, **Fig. 1**, is a complete receiver operating on the 40m (7MHz) band. The voltages shown are actual measured spot values, which may help if any problem arises. I built it some years ago to listen while cruising around the Mediterranean and therefore it had to be a simple, lightweight design drawing minimal power. The whole receiver consumes about 9mA in total. To this day it is still working fine and is a joy to use because it is very quiet when tuning between stations (at least, when any local noise is not a problem). In fact, it receives just as well as any of my other receivers. It exhibits at least 60dB of total gain but, as we know, it has no sideband suppression. Being such a simple design, it recovers signals very cleanly so variations in audio quality of the transmitting stations are easy to distinguish. It is only designed to receive SSB or CW but zero beat on AM is possible. There is no reason why it couldn't be used for any frequency in the HF spectrum. It is only a matter of changing the VFO frequency, together with using a suitable tuned circuit at the antenna input.

Notice the oscillator supply stabilisation using the indicator LED and a couple of silicon diodes, which resulted in a stable 4.2V plus a switched ON indicator LED. The 2.2kΩ resistor can be adjusted to give a different LED brightness. Also

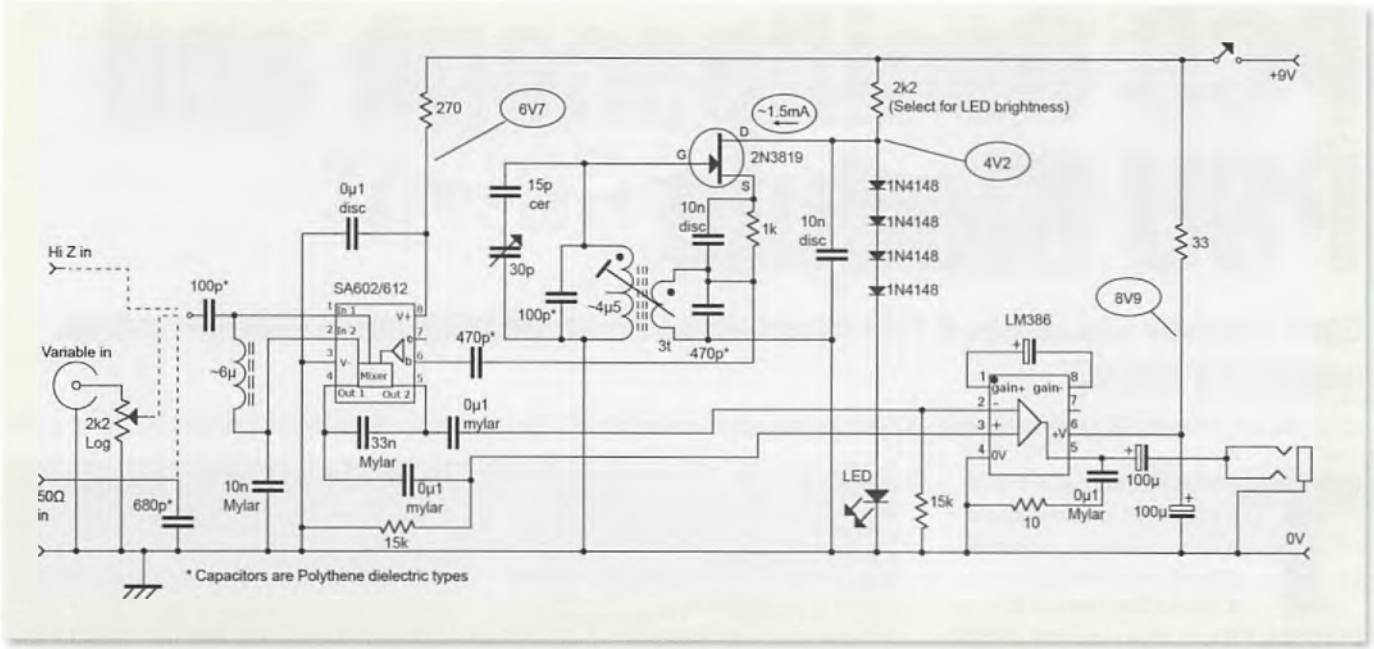


Fig. 1: Complete circuit of the 40m direct conversion receiver.

detailed are the type of components used. Disc ceramic capacitors are best for decoupling and polythene types are better for frequency determining places. If the capacitor is an electrolytic type, the correct polarity is indicated and must be observed.

The coil is 13 turns wound on an Aladdin former which is approximately 7 to 8mm in diameter with an iron dust core but any similar former should be fine to obtain about 4.5µH. However, it would need an adjustable core to set the coarse frequency. The 30pF variable and series 15pF ceramic across the 100pF poly cap provided a neat, almost 200kHz, band coverage and the 15pF ceramic had a suitable temperature coefficient to keep things stable. I found all this by experiment once the receiver was operational. Notice that the oscillator feedback is via the three turns link in the FET source lead, which also provides a low impedance output via a 470pF capacitor to inject the oscillator signal into pin 6 of the 602.

NE602 Pin Connections

Pin 1 of the NE602 is the RF signal input and is at a medium impedance (1.2kΩ). This helps to maintain a reasonably broad input bandwidth. The circuit shows details of several ways of coupling the antenna at the input. The antenna input circuit consists of a 6µH coil made from four turns through a small ferrite bead. The bead (FX1115?) was salvaged from an old TV circuit board and was then used as a parasitic stopper on a transistor base lead.

The 100pF on pin 1 gives the coil a broad resonance over the 40m band and if it's connected in series with a 680pF to ground, it enables a 50Ω input, if required. The input circuit could be a conventional tuned circuit plus a coil tap for the antenna input. This was needed at my home location when using a big doublet antenna, which produces a huge voltage from those broadcast stations just above the 40m band.

The 602 mixer chip has about 16 to 18 dB of gain from input to output, together with a third order intercept of about −15dBm (40mV across 50Ω).

Pin 2 is the signal ground connection but must be isolated from any DC supply ground using a 10nF (0.01µF) capacitor but could be a 100nF mylar type or a disc ceramic.

Pin 3 is the supply ground and the negative supply rail.

Pins 4 and 5 are the push-pull (differential) output from the mixing process. The 100nF coupling capacitors with the 15kΩ load resistors give an acceptable audio frequency range to accommodate both SSB and CW. The 33nF reduces any frequencies above a few kilohertz. All these values were carefully selected empirically while observing the audio output spectrum with an analyser.

Pin 6 is the local oscillator input from the FET oscillator as detailed above.

Pin 7 has no connection.

Pin 8 is the 602 positive supply rail, which is isolated using a 270Ω resistor and a 100nF disc ceramic capacitor.

The 386 Audio Amplifier

The 386 is a more established and conventional chip for audio amplification so when used in a direct conversion receiver, it is very often used at its full gain capabilities. However, it needs to provide a given frequency response to assist in the overall selectivity. The voltage gain of the 386 when set to a maximum is about 46dB (200 times). The output also needs to have a certain frequency-conscious load arrangement. This is normally catered for by using a low value resistor and a series capacitor, an arrangement often referred to as an 'anti-hunting' circuit, to round off any high AF (Audio Frequency). A 10Ω resistor in series with a 100nF mylar capacitor was used here to damp any instability.

Pins 1 and 8 have a 10µF capacitor connected between (check polarity) to achieve maximum gain. The datasheet gives plenty of information about the various gain adjustments.

Pins 2 and 3 are the push-pull audio input from the mixer.

Pin 4 is the ground and negative supply rail.

Pin 5 is the audio output via a 100µF electrolytic (observe polarity).

Pin 6 is the positive supply rail decoupled by 100µF and a 33Ω feed resistor.

Concluding, there is no excuse for anyone not to able to monitor the HF amateur bands. Just build a DC receiver! You could even have it band-switched using plug-in coils and so on. The datasheets for the various devices are readily available on the internet.

• E-mail: geofftheasby@gmail.com

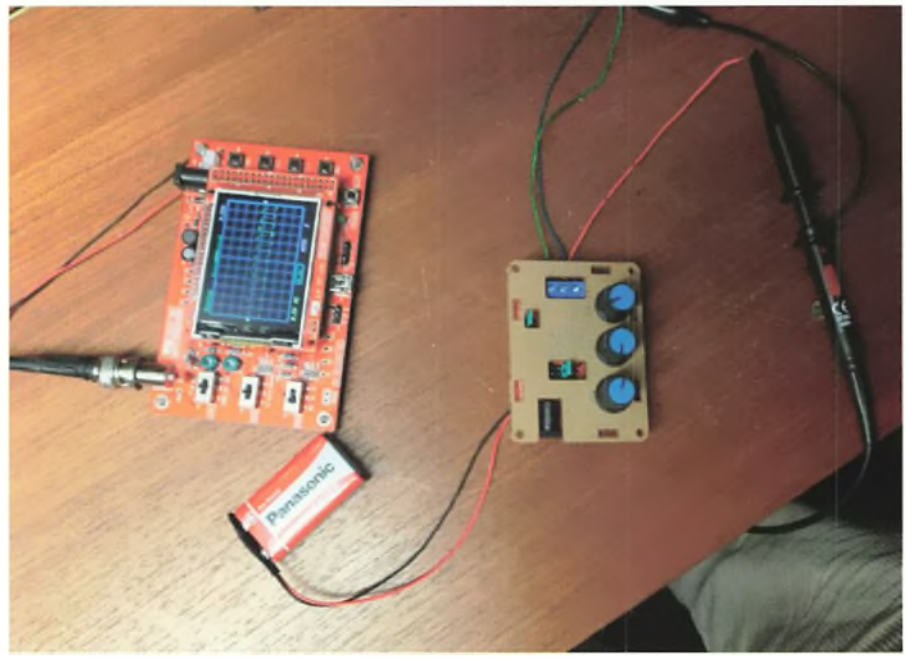
PCB Oscilloscope and PSU Module

Geoff Theasby G8BMI has a PCB oscilloscope for around £10 and a variable voltage module for just £3.

This oscilloscope is not a project for the beginner! It contains several surface-mount components 2 x 1.2mm (0805) on a compact PCB, 80 x 115mm, with a display piggy-backed on. One 48-leg IC is presoldered for you (Phew!). A few test points need to be shorted with solder after setup but the copper foil is very thin and can peel off if treated badly. I prefer to use a thin bare wire to bridge them; a cut-off resistor leg will do. The instructions are the best I've yet seen, in full colour, on glossy paper, with circuit and full test results and setup details. The project took me eight hours of slow and careful construction, checking carefully, testing voltages and so on, in order to achieve success. Make sure you get the JYE Tech, red, PCB kit to avoid a common counterfeit. Three resistors were left over and one was missing, fulfilled from my stock. With a maximum input of 200kHz, this is not for RF work but is nevertheless a versatile tool for the bench and even comes with its own oscilloscope probe. The unit requires a supply of 12V maximum, at 200mA. It costs about £10.

Stage 1: insert surface mount components. These measure 2 x 1.2mm and are held with tweezers, soldered in place. If you place all resistors the same way round and right way up, this makes it resemble a project built by a competent constructor. A dozen such components took two hours to fit, aided by a large magnifier, good lighting and steady hands. This last I do not have... A hands-free magnifier is a great help, as is a jeweller's loupe.

Stage 2: leaded resistors. These are colour coded, with which I am familiar, but again so small that I have to check their resistance with a (digital) test meter (No, it isn't futile!). The rest of the components are routine to fit, making sure they are on the correct side of the PCB and observing polarity.



The oscilloscope, displaying an output from a function generator.

Detailed setup notes and basic usage instructions are provided, including probe calibration. There is a small amount of residual noise on the display, making it look a little 'hairy', but what do you expect for a tenner? In the photo it is displaying an output from the Function Generator (*PW* November 2017).

Variable Voltage Module

Using an LM317 IC on a small heatsink and controlling a maximum current of 2A, the built module this month is an adjustable voltage regulator for £3. An awkwardly-placed two-digit seven-segment display shows voltage out (above 3V) and the input can be 20V AC or 30V DC. The board contains a bridge rectifier. A single potentiometer adjusts the voltage out, which can range from 1.25V to 28V at 2A. Very useful for a bench power supply, if fed with an old CB 12V power supply, 'wall wart' or transformer. The voltage out could be better displayed by attaching an outboard 3½ digit LED voltmeter, which are often available at rallies for £1.

The variable voltage module.

***(Editor's note:** At press time eBay carried various JYE Tech oscilloscope kits from £13.27 upwards. I didn't find the exact variable voltage module on eBay but a Google search offered various sources.)*

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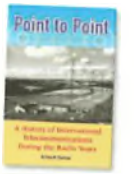

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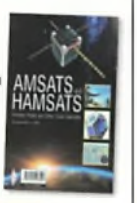

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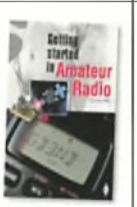

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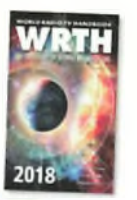

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A Regenerative Receiver

David Jardine G0FDV challenges readers to build a one JFET regenerative radio in an afternoon.

I built my first AM transmitter (for the 1.8MHz band) at the age of 16 under the supervision of my dad G5DJ in the days when we used Mullard valves (807s or 6146s?) in the PA and 180V DC to power the ECC83/EL81 audio-based modulator and PA stages plus huge power supplies with 16 and 32µF capacitors. We used massive RF chokes for smoothing. But that project took far more than an afternoon!

The above individual items would weigh as much as several house bricks and took up as much room, plus they got hot enough to heat a living room and that's just the valves, mains and audio transformers plus RF and mains chokes.

We even had a huge topband 1.8MHz dipole, 32ft high as I recall, which went from the top of our house up our long garden and centre-fed by 50Ω coax – quite a cumbersome setup but capable of reaching Wales and the North of England with ease and just 10W!

This experimenting got me into home construction, which stopped for over 45 years until I resurrected my amateur radio interests just recently by building a regenerative radio. The fascination of putting together a few discrete minute components such as transistors, capacitors, chokes and resistors and seeing how they can capture signals from the ether is very rewarding. At the same time, you can remind and/or teach yourself some basics of electronics by experimenting with major and minor changes to circuitry and suchlike.

First Steps

My first steps took me to building a one-transistor regenerative receiver using the versatile 2N3819 Junction Field Effect Transistor (JFET), **Fig. 1**. Because I dislike the use of headphones, I added a three-transistor amplifier using three 2N2222 devices, **Fig. 2**. This provides enough output to feed an 8 or 16Ω loudspeaker very satisfactorily and can even fill the entire house with sound.

This regenerative receiver is a design by **Raymond Haigh** published in *Everyday Practical Electronics*, August 2003, and the reason I built it is because it can easily be constructed in an afternoon provided you have the basic components and can wind coils rapidly. The results are simply quite stunning but you need a decent antenna (I use the 'half dipole' of my G5RV and a good earth (mine is a copper rod deep into the ground).

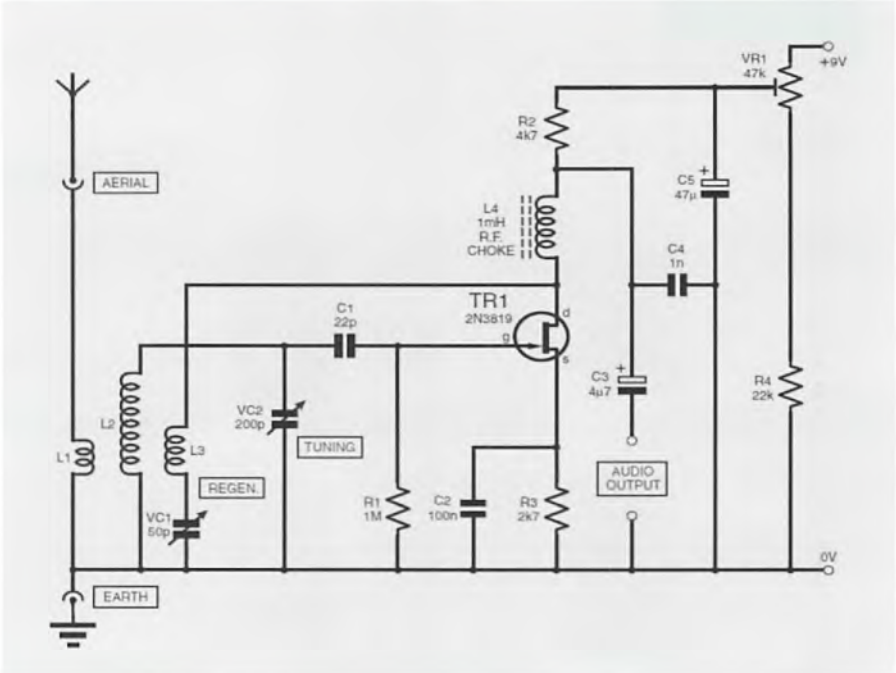


Fig. 1: Circuit of the basic regenerative receiver.

The basics of this circuit go back to **Edwin Armstrong** who discovered the regenerative principle back in 1913, apparently by accident. Obviously, there were no solid-state components back then but he noticed that there were radio frequencies at the anode (output) of the valve he used so he connected a tuned circuit to this output and fed it back to the grid's tuning coil by placing it in close proximity. He observed that the circuit began to oscillate and by cutting back on this 'feedback effect' slightly, he found that there was an enormous rise in the selectivity and sensitivity of the circuit configuration. Forward five or six decades and translate these findings into the semiconductor age and we have a host of circuits using identical techniques to Armstrong's circuit with small modifications. See, for example, the circuit in **Fig. 3**, which is from G3UMP and originally published by the RSGB. These circuits are all very similar and use virtually identical techniques.

Armstrong's discovery revolutionised radio reception in subsequent years. Signal levels can be increased by a factor of 1000 as positive feedback is increased along with the *Q* of the initial tuned circuit. Remember, *Q* is the ratio of voltage across the inductor or capacitor to the voltage across the effective resistance of the circuit. Therefore, at resonance $Q = 1/2\pi \times CR$. The *Q* can be varied considerably by altering winding lengths and positions of coils in this circuit.

What's the Point?

So, what is my point about all this? Well, so much can be learned about principles of electronics by putting this circuit together as I discovered. I've kept it on a breadboard for ease of making changes.

In Fig. 1 we see a modern version of the Armstrong circuit, introducing a 'tickler coil' L3 that controls the regenerative effect. Originally, the circuit consisted of this tickler coil in place of the RF choke at L4 and

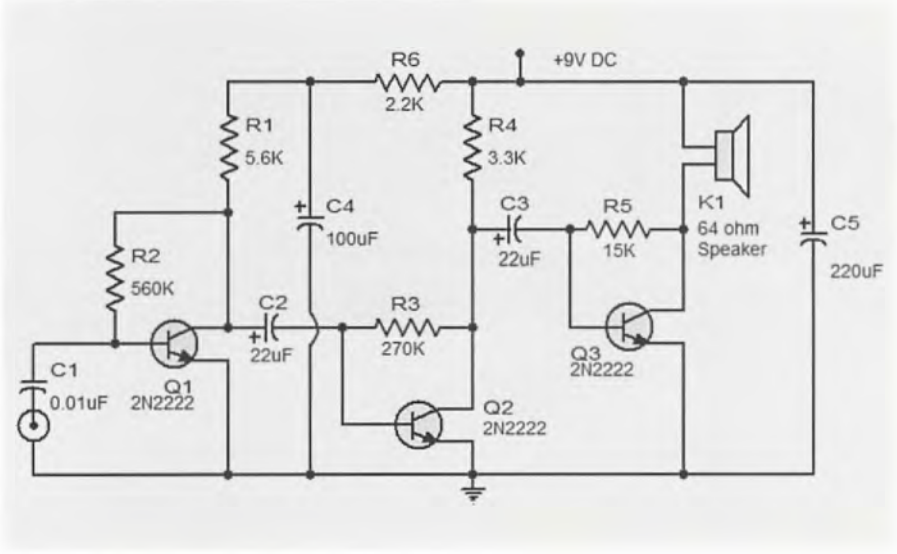


Fig. 2: The three-transistor audio amplifier.

feedback was controlled by moving it closer to or away from the coil at L2.

This is undoubtedly a clever circuit, especially the first stage because, in effect, the combination of L1 and L2 is acting as an impedance-matching device between the low impedance of the antenna and the high impedance of the L2/VC2 tuned circuit. This, in turn, is connected to the high impedance gate of FET TR1. The gate also requires high impedance so this is well matched. Also, the combination of the two coils L1 and L2 acts as a transformer. Taking the square of the ten turns in the antenna circuit with the square of the 100 turns in the L2 coil and dividing turns in L2 by L1 gives an impedance increase and 'RF voltage amplification' that is considerable. I have observed too, how moving the position of any of the coils but especially the antenna coil L1 makes a huge difference to reception in terms of selectivity. Also, the Q of the main tank circuit L2/VC2 can be dramatically improved by sliding L2 along the ferrite.

Coil Windings

Coil windings should be as follows:

L1 – approximately 8-15 turns (you need to experiment with this for improved selectivity and performance)

L2 – 80 to100 turns approximately

L3 tickler coil – 40 turns approximately.

From mutual inductance theory we learn that if primary impedance is Zp and secondary impedance is Zs, while Np is number of turns in the primary winding and Ns the number of turns in secondary winding, then:

$Zs = (Ns/Np)^2 \times Zp$

Hence, we look at an impedance transformation of over 100 times. This is ideal for the L2/C2 circuit and subsequent FET high impedance input. I was absolutely amazed at the incredible gain produced by this simple circuit when low signals from remote parts of Europe can be greatly amplified and listened to with ease, especially when the tuning coils and capacitors are correctly adjusted for maximum sensitivity and selectivity.

Similarly to the above formulae, the ratios of current or voltage increases are in direct proportion to the turns ratio (that is to say, not squared in this case), so:

For voltages: Vs = Vp × no. of Secondary Turns divided by Primary Turns

For current: Ip = Is × no. of Secondary Turns divided by Primary Turns

There is no increase in power as such, because energy doesn't come from nowhere – these are passive components.

Some More Theory

While I'm covering some basic theory here I should mention about tuned circuits, in this case the L2/VC2 combination. For tuned circuits at resonance the frequency is as follows:

$F_{(res)} = 1/2\pi\sqrt{LC}$ (L in Henrys, C in Farads)

This is a handy and effective formula for working out where the receiver will be tuning. The circuit can be adjusted for higher frequencies such as the amateur bands by using this formula.

In a parallel-tuned circuit at resonance there is maximum impedance and for a series-tuned circuit there is minimum impedance at resonance. I used a low impedance antenna (a piece of wire running through my attic). The inductance of the antenna coil and its ability to be moved around the ferrite rod can counteract this mainly capacitive reactance for a better match. I could possibly have used some taps on the coil for experimentation.

I learned much about impedance matching from various sources and, to cut a long and complicated theory short, it can be said that matching impedances is analogous to the gearbox in a car. For maximum power transfer of the engine's force to the wheels there must be a match or power is lost. For example, try driving your car away from stationary by using top gear. It can be done with skill but is an extremely inefficient transfer of power. Think of driving at 70mph in first gear (don't really do it though). The same in electronics – maximum power transfer is achieved when source and load impedances are matched. As mentioned above, for purists, a series capacitor could, in theory, be added after the antenna coil (or a series of taps on the coil) to match the antenna's likely capacitive reactance/impedance with its inductance to more useful levels. I didn't find this necessary in the construction of this circuit. I did find the use of a medium wave ferrite core very useful (in fact the radio picked up virtually no signals without it). The inductance of the ferrite rod means fewer turns in the coils are needed, so it simplifies everything.

What is happening using a ferrite rod is that the rod picks up the magnetic part of the signal from the airwaves and is extremely efficient, especially because its frequency (medium waves) is matched to the RF circuit in question. In order to obtain decent selectivity with the many incoming signals from the antenna coil, it is important that a ferrite rod is used for the main tuning tank circuit wound on the same ferrite as the other two coils. This is in effect 'picking off' the signal without loading the antenna circuit and affecting the impedance and thus ensures a high selectivity or Q. I experimented by moving the antenna coil (which is just eight to ten turns) along the ferrite rod and was able to improve selectivity quite effectively. I could also tune across quite a large section of the broadcast band by sliding the rod in and out of the three coils, since it dramatically changes the inductance.

Being a regenerative radio, the real art is in the feedback or 'tickler' coil circuit as it is called. This is shown in the circuit and consists of L3 and VC1 so that VC1 controls the feedback amounts from the drain back to the gate of the 2N3819 FET via the inductive coupling between L3 and L2.

L2 simply picks up this (undamped) signal and amplifies it again and again, up to perhaps 1,000 times. It doesn't load the main L3/VC1 feedback circuit.

At this stage it is important that all three coils are wound in the same way, either all clockwise or all anticlockwise around the

ferrite, or there will be serious unwanted phase shifts. This 'tickler' coil consists of approximately 40 to 50 turns of 24 SWG copper wire – the same wire gauge as the other two coils. It actually 'picks off' signals without affecting impedance. Because the *Q* of the tuned circuits is raised, there is a dramatic improvement in selectivity across the band.

The FET is acting as a rectifier (like a diode) but achieves this through the action of the gate/source junction of TR1, the source bias being developed across resistor R3 and the RF being bypassed by C2. C1 blocks any audio voltage appearing across R1 that could be shorted out by the main tank tuning coil.

The drain load resistor at R2 develops an audio signal after the choke and L4 blocks any stray radio frequencies, which are also eliminated through C3.

Building the prototype on a mounting board, **Fig. 4**, makes experimentation much easier and I even found to my utter amazement that the circuit still works to a very limited degree (it will pick up a mix of MW transmissions) without the FET in place. I assume that one, or some of, the 2N2222 transistors in the audio amplifier somehow rectified signals and that got fed back into the first RF stage!

For further reading, there are a number of excellent articles on the internet about regenerative radios such as Wikipedia at: https://en.wikipedia.org/wiki/Regenerative_circuit

Also, if you do a search for regenerative radios on Google and select 'images', there is a plethora of interesting circuits using many different semiconductors.

Finally, for an excellent source of coil winding information, check out **Peter Vis** (website below) whose advice was of great help in putting this circuit and article together as well as regenerative circuitry and coil theory information. See: www.petervis.com

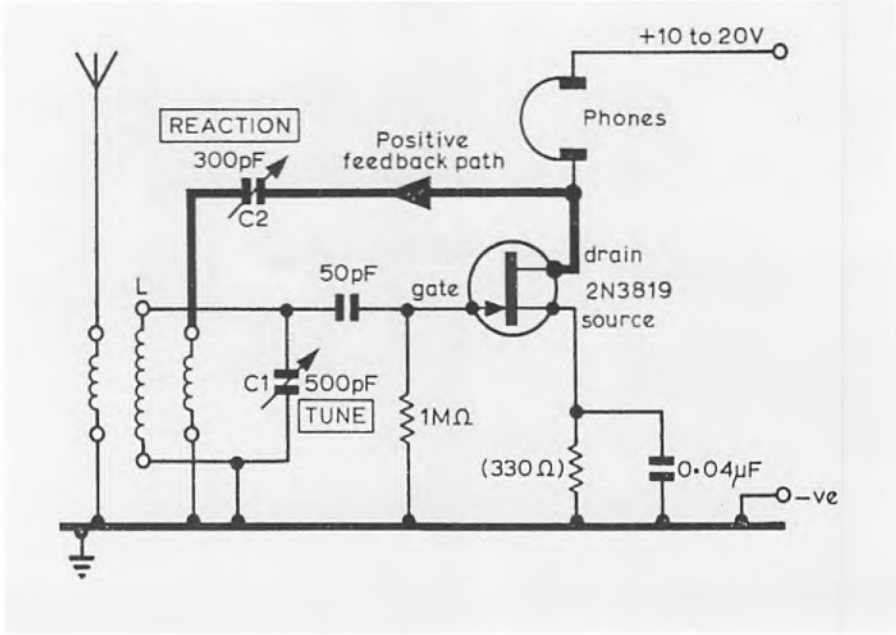


Fig. 3: A design by G3UMP, published by RSGB.

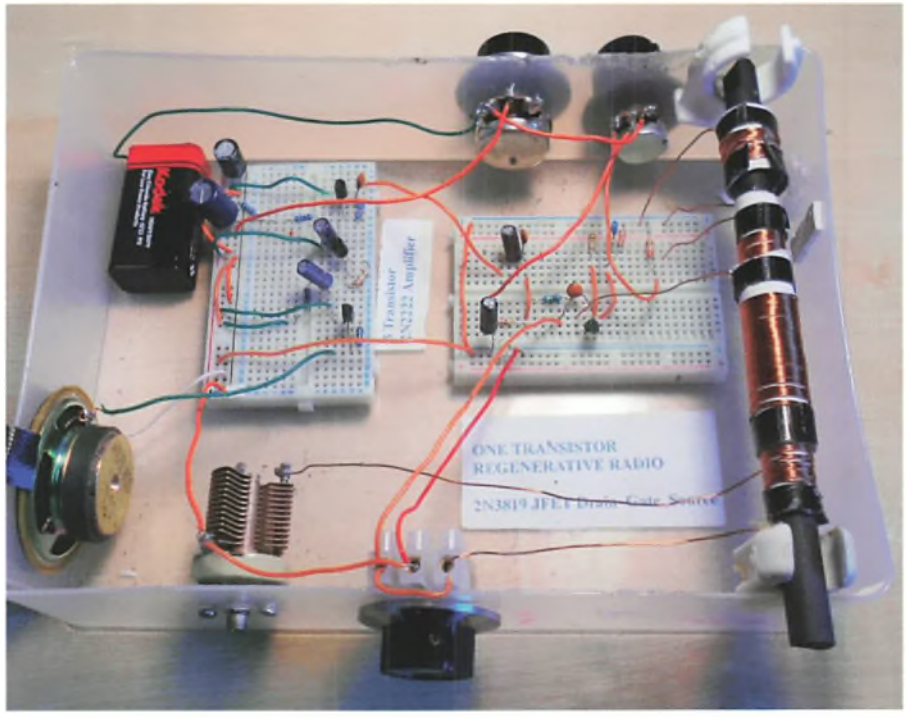
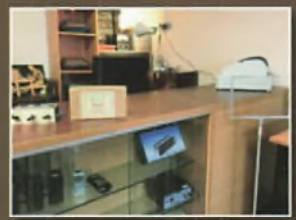


Fig. 4: The circuit as built on simple prototyping boards.



E-mail: military1944@aol.com

Pye PMR Equipment

Bernard Nock G4BXD takes a canter through a selection of classic sets from Pye of Cambridge.

One area of the hobby of amateur radio that has diminished quite considerably over recent years is the re-use of ex-commercial equipment, notably sets from the Private Mobile Radio (PMR) industry. Many amateurs active in the 1960s through to the 80s were used to being able to obtain ex-PMR sets at rallies and the like and adapt them for use on the amateur bands, usually in the VHF bands of 4 and 2m and the 70cm UHF band.

There were many firms supplying these radios to industry: Marconi, Motorola, Philips, Dymar and one of the biggest, Pye. Pye radios in their distinctive light blue livery were to be seen in nearly every amateur radio shack in the 1960s and 70s. Many amateurs used them mobile and portable and modified them for roles they were not designed for. Mains powered base stations were also made and available but the quantity of mobile sets was much greater.

These radios provided an easy and cheap source of getting on the bands with the slight drawback that most of the sets needed quartz crystals to set the operating frequency, usually two per channel, one for the receiver and one for the transmitter.

I'd like to illustrate some of the Pye range that many of us broke our teeth on, so to speak, when starting in the hobby. Being mobile radios, most are 12V operated. Some early sets were 6V and adapters, again made by Pye, were produced for 24V vehicles allowing the 12V sets to be installed and operated.

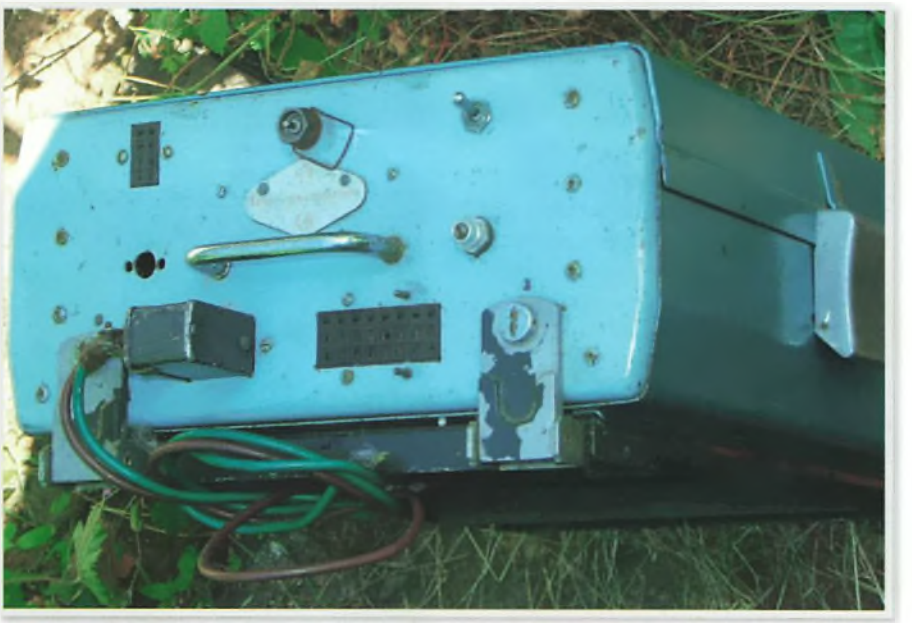


Fig. 1: The Ranger.

The Ranger

The Pye Ranger introduced the third generation of mobile and fixed station circuit design and evolved into a very large product family that included AM, FM, front mount, short-remote and long-remote mounted versions along with marine equipment. This third-generation design was suitable for all channel spacings between 20kHz and 120kHz, which enabled the company to supply to a wide range of international type approval specifications, including the difficult Canadian market.

The front-mount Ranger was initially designated PTC143, and the series type number designation later changed to PTC2000 for AM and PTC8000 for FM. Each equipment was made up of three individual chassis (receiver, transmitter and PSU), which allowed great flexibility and enabled a matching fixed station equipment to be developed from the common chassis assemblies.

This construction can be more easily seen in the large 25W boot-mount version, ***Fig. 1****, and with the cover removed,* ***Fig. 2****. It is interesting to note that as late as 1962 the Ranger and F27AM fixed stations were still being fitted with the old wartime Pye coaxial connectors.*

The boot version sat, as the name suggests, in the boot of the vehicle and a small control box was fitted on or under the dashboard of the vehicle. The dash mount sets, **Fig. 3**, were fitted inside the car or truck cab, usually under the dashboard.

A boot-mount Ranger was one of the first sets I ever used on the 2m band. Using a QQV-0620 in the output stage and a pair of 6V6 valves in the modulator and with the HT tappings set to their highest level, of course, the set gave me a great signal. On the receive side I did use a nuvistor converter into an HRO set, though. At Christmas time I ran the RF output into a string of fairy lights – not to be recommended with modern sets.

Facts: 1955 – 1963. 25 – 174MHz in nine bands. 5W AM, 15W AM, 25W AM, 10W FM, 25W FM.

The Cambridge

The Pye Cambridge series of front mount, ***Fig. 4****, and boot mounted equipment, again with just a small control box on the dashboard, was a very successful family of fourth generation mixed technology equipment design, with all solid-state receivers and valve transmitters giving RF power outputs of 5, 15, and 25W. Initially designated the PT. D10 AM, the type*

number was changed to AM10D etc. in 1963.

The higher power Pye Continental FM models BC25 and DC25 were originally given the designation B20FM and D20FM. A UHF remote mount was also created, based on the low-band version but equipped with an extra receive down-converter, which made the receiver a triple superhet.

The transistorised receiver (internals shown in ***Fig. 5****), designed for the Cambridge series, was widely used in both the higher-powered Vanguard family and also in the matching fixed station receivers of the time. The product was replaced by the Westminster series of AM and FM front and boot mounted sets.*

The Cambridge proved very popular with amateurs due to its compact size and weight. In addition to the VHF version there was a UHF version with an extra stage in the transmitter and a down converter in front of the usual front end tuner. It was easy to get it working on the amateur bands and many were modified with S-meters being fitted and even VFOs installed to make them tune the whole of the band on receive at least.

Facts: 1961 – 1970. 25 – 174MHz in ten frequency bands. Cambridge, 5-7W AM, 15W FM, Continental, 25W FM.

The Vanguard

The Pye Vanguard was a family of high power remote mount mobiles and was the first of the fourth generation of mobiles that included the Cambridge series. The design used a sealed block LC filter for receiver IF selectivity, as opposed to using distributed interstage bandpass filtering by transformers. See external, ***Fig. 6****, and internal,* ***Fig. 7****, views of an AM25B transistor receiver valve transmitter version.*

The Vanguard was originally designed to meet a requirement specification issued by the UK Home Office. Pye won the contract with the PT B10AM design, which started production in 1962 and following the success of the product, created a range of standard commercial versions.

The initial PT B10AM and AM25B models were valve designs with transistors used in the audio and power supply circuits. The later AM25T and FM25T versions used the same fully transistorised receivers as the Cambridge AM10/FM10 series. Transmit powers of 20W AM and 60 or 100W FM were available. A 30W

Fig. 2: Inside the Ranger.

Fig. 3: The dash mount Ranger.

Fig. 4: The Cambridge dash mount set.

Fig. 5: Inside the Cambridge.

Fig. 6: The Vanguard.

Fig. 7: Inside the Vanguard.

Fig. 8: The Handy Cambridge.

Fig. 9: Under the front cover.

UHF FM version, the U30FM, was also produced.

The product family was first introduced as the PT B10AM, PT B25AM, PT B25FM and PT B100FM but was later renamed Vanguard AM25B, AM25T and FM25B. The designation B100FM remained for the 100W version. Various marine variants were introduced as was a fixed station version in a distinctive green cabinet.

The Vanguard product was partly replaced by the Westminster W25FM and W30AM series remote mounts but the Company did not produce high power RF output mobiles again until the 100W PMR2 model of the early 1970s and the 50W M206 of the late 1970s.

The Vanguard was again very popular with amateurs due to its high power output. I used one in the boot of my Mini (the real Mini) in the 1980s and also the transmitter section, cut out of the main chassis, and added an FM modulator when that mode came into amateur use in my shack.

Facts: 1962 – 1970. VHF 25 – 174MHz, UHF 450 – 470MHz. AM25T 20W, FM25B 60W. B100FM 100W.

The Handy Cambridge

*The AM10P/FM10P/CM10P Handy Cambridges, **Fig. 8**, were a family of transportable mobiles constructed using modified boot-mount Cambridge chassis and case parts. AM, FM and FM-Marine versions were available in single- or six-channel configuration. The Marine version had a low/high power switching facility.*

A choice of batteries was offered; either a sealed lead-acid battery of 9Ah capacity or nickel-cadmium cells of 6Ah capacity. These were mounted in a detachable container at the base of the unit.

*An internal speaker was fitted under a lid, **Fig. 9**, which covered the controls. A quarter-wave fibreglass whip antenna (fitted with a PL239 connector and elbow adaptor) could be mounted on one side of the equipment case and a waterproof microphone clipped onto the other side.*

Later models were fitted with a helical whip antenna. The battery charger used was the BC2. Weight: 20lb (9kg) with NiCd battery or 22lb (10kg) with lead-acid battery.

Compared to today's tiny Chinese handhelds the set does look a bit of a joke and must have been very heavy to carry around but, at the time, it was a radio telephone you could take with you into the field and actually use.

And Finally

In the next chapter I'll continue the theme with several more of the Pye range that were available to amateurs back in the day, including some very cute handheld sets that still look good and stylish today. Cheerio.

Thanks

All history, development and facts, including quoted material in italics, are taken from, and with permission of, the Pye History Trust's super website: www.pyemuseum.org

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VFO Jumping and Wobbling

Harry Leeming G3LLL addresses another selection of strange faults and even stranger customers!

The FT-901, FT-902, and the FT-101ZD (and several other Yaesu rigs made around the same time) use the same VFOs and these sometimes develop problems that cause them to jump around in frequency. The common cause is that the VFO internal/external switch or the clarifier switch is intermittent and needs cleaning. As I have mentioned previously, for some strange reason the only cleaner that seems to work on these push button switches is WD40, much to everyone's surprise. There is, however, another problem that can cause this effect.

Ron had an FT-101Z that would occasionally start wobbling in frequency so that SSB transmissions and reception became undecipherable. I put it on in my workshop and, of course, it functioned perfectly. I popped it in a corner, left it running with the calibrator switched on so that I could just hear a steady beat note, and it remained like this all day without any wobble showing. The night was a cold one and when I when I went into the workshop the next morning, this seemed to have triggered Ron's problem. As soon as I switched his rig on it started warbling and jumping about in frequency. Sometimes with odd faults it's worth trying the effect of the various controls and I noticed that switching the clarifier off reduced but didn't completely cure, the wobble. This seemed strange until I had a good look at the circuit diagram, **Fig. 1**.

When the clarifier is switched on, the feed to the capacity diode in the VFO comes from the centre of the potential divider formed by the 5kΩ clarifier potentiometer and R01 and R02, a total of 13kΩ. When the clarifier is switched off, it is fed from the fixed potentiometer formed by VR01, R05 and R03, a total of 3kΩ. This means that the clarifier line is of much higher impedance when the clarifier is switched on so is likely to be more sensitive to any leakage. Poking around in VFOs can be a rather dicey operation because it is easy to upset the calibration but a glance at the service manual showed a likely culprit that would be easy to get at. Mounted on the back of the VFO's input and output socket, shown in **Fig. 2**, is C25, a 0.33µF electrolytic capacitor, which is intended to remove any noise from the clarifier voltage input. Small electrolytic capacitors are rather prone to becoming leaky so I unsoldered it. This sent the VFO a few kilohertz off frequency and removed the wobble. When I tested C25, it did indeed prove to be leaking slightly.

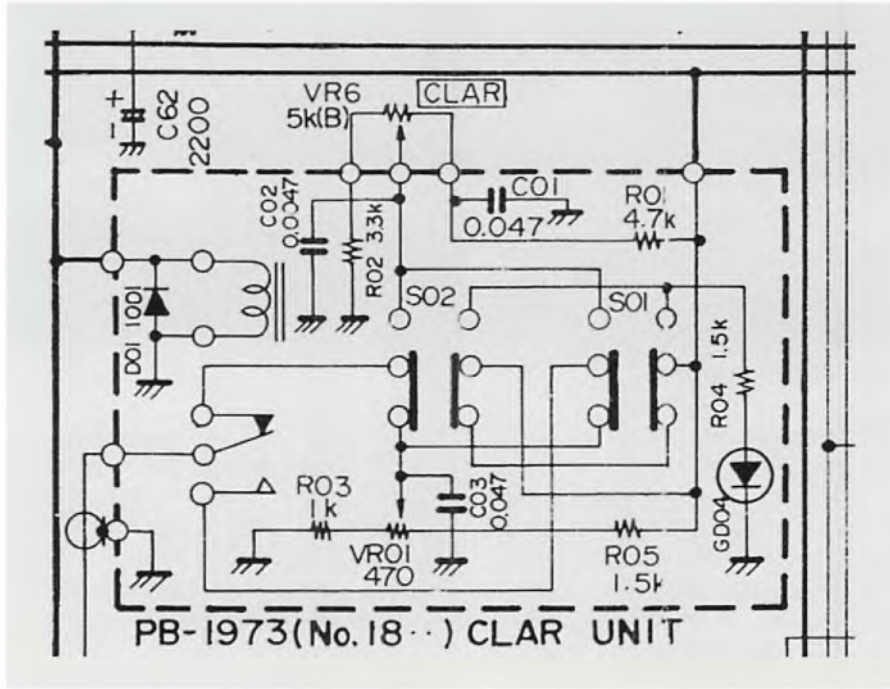

Fig. 1: Circuit of FT-101Z clarifier unit.

I didn't have a low leakage electrolytic capacitor of the correct value to hand but given that the value isn't critical, I substituted a 0.22µF polyester capacitor and the fault was cured. I then cleaned the push buttons and centred the clarifier control using VR01so that the frequency was the same with it on or off. Just to make sure, I left the rig running for a few days and all was well. Since then I have had a few occurrences of VFO wobble caused by C25.

A Fair Warning or a big Con?

Handheld rigs are usually sold with a rechargeable battery pack and sometimes have available, as an accessory, a dry battery box marked *"must not be used with rechargeable batteries"*. Obviously, the manufacturers would prefer us to purchase their rather more expensive spare rechargeable battery pack but is this the sole reason for the warning?

If you happen to put a spare battery box fitted with a full set of dry batteries in your trouser pocket, along with a set of keys or some coins, it may become shorted out and get rather hot. If, however, it contained NiCads, it could pass tens of amps, end up literally red hot, and you could then run a serious risk of you having some of your rather important very personal accessories damaged. If you must fit rechargeable batteries, cut one of the battery box's internal connections and bridge the cut with a 1A fuse.

Wrong Information

Tom brought in an FT-101 that he had

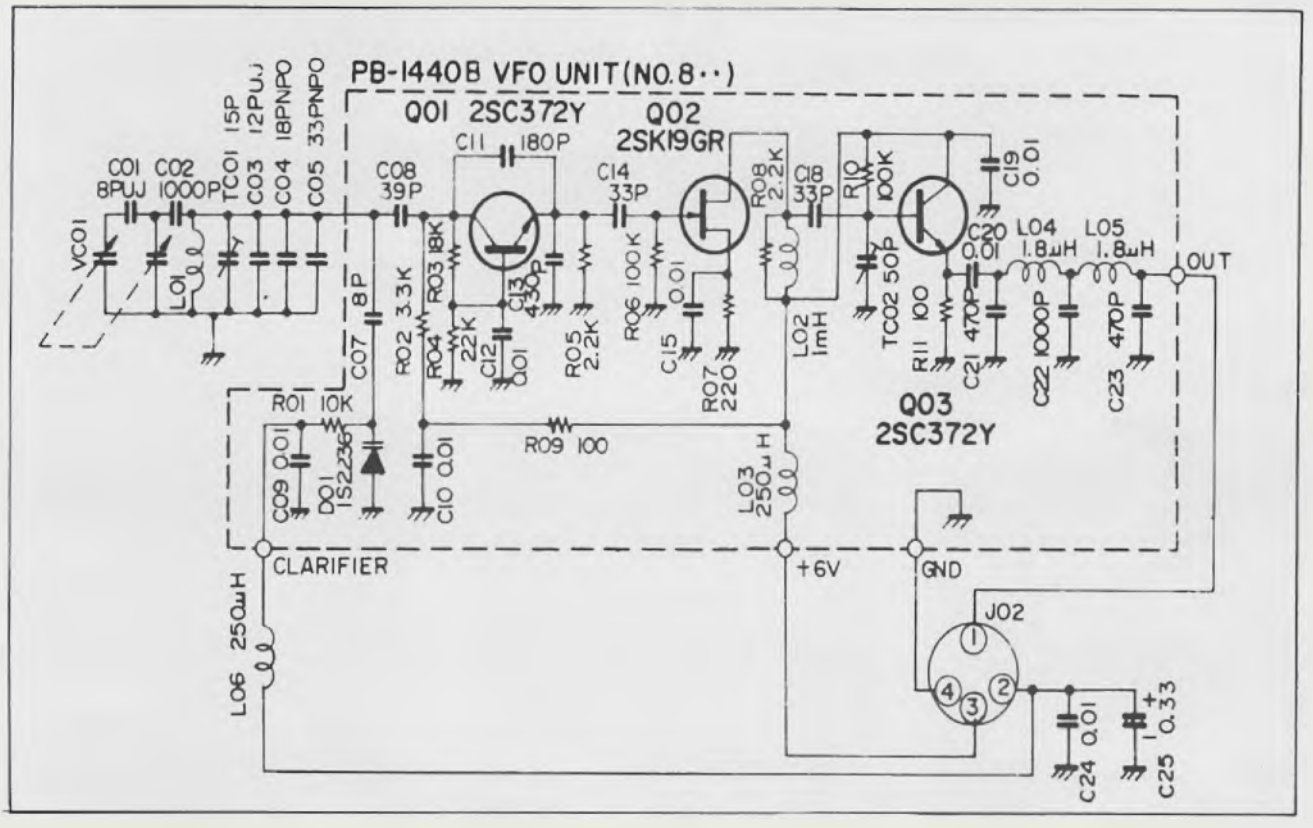

Fig. 2: FT-101Z VFO circuit.

bought cheap at a rally. He had been told that the mains transformer was burned out but that he could purchase a 12V DC lead from me and then run it from a 12V PSU! Unfortunately, when you run older rigs like the FT-101 from a DC supply, the valves still need a few hundred volts to operate them. This is normally obtained by using the mains transformer in a high power oscillator circuit. I told Tom that to obtain and fit a new transformer would be extremely expensive and that a DC lead would only enable him to operate the rig on receive. I made him a small offer for the rig, for spares, but he refused, and took it away rather disappointed.

A Rather Better Buy

A frequent *PW* contributor told me about rather a good buy that he had made at a rally. He was wandering around when he noticed a Yaesu rig for sale at a low price, marked *"Will not transmit"*. He wondered about this. Nearer to closing time, he came back, started, to examine it, and noted that the 11-pin accessory plug was missing from the back. He carefully avoided seeming too enthusiastic, haggled a bit, and bought it at bargain price.

It must have been his lucky day because when he got home all he had to do was to borrow an 11-pin accessory plug from another rig and his new purchase worked perfectly on all modes. The 11-pin accessory plug, which is fitted to most of the older Yaesu rigs with valve PA stages, has a link that completes the heater circuit to the final amplifier valves. It is most useful when doing service work because removing it ensures that you cannot accidently transmit. It can also be used to power some of the early valve 2m transverters with heater and HT supplies, which, indeed, is why it was designed this way because not only does it provide those external supplies but it disables the normal HF PA in the process.

On the minus side you should be aware that it can 'bite' because one of the pins has nearly 1kV on it so don't grab it when picking up a rig it if its cover is missing, even if it is switched off. It has been known for the internal PSU to hold a charge, resulting in one unlucky owner dropping his rig down a flight of stairs, which reminds me...

"I Dropped it Down the Stairs"

When we were operating our shop at Johnston Street Blackburn, almost opposite a friend **Eon** (yes that is the correct spelling) ran a TV and video repair business. A customer brought in a rather mangled video recorder, told Eon that he had fallen down the stairs with it, and asked for an estimate for its repair. Eon took the recorder in his workshop for a few days, had a good look at it, and wrote an estimate The cost was so high that it was really beyond economical repair. Unwisely, he made no charge. The customer did not seem at all upset by his verdict, took his video with the estimate, and went away.

Not long after another customer arrived with a video recorder and the same story. Eon smelled a rat and because he didn't want to be involved with some insurance company scam, he quickly decided that estimates for video recorders involved a lot of work and cost £75 paid in advance. The customer was somewhat taken aback and blurted out, *"Well you didn't charge my mate"*. To this Eon replied, *"I thought he was coming back, please remind him that he still owes me £75"*. That was the last that he heard of it but, on the 'grapevine', he found out that until the insurance companies got wise to it, this was a favourite way of obtaining a new video recorder.

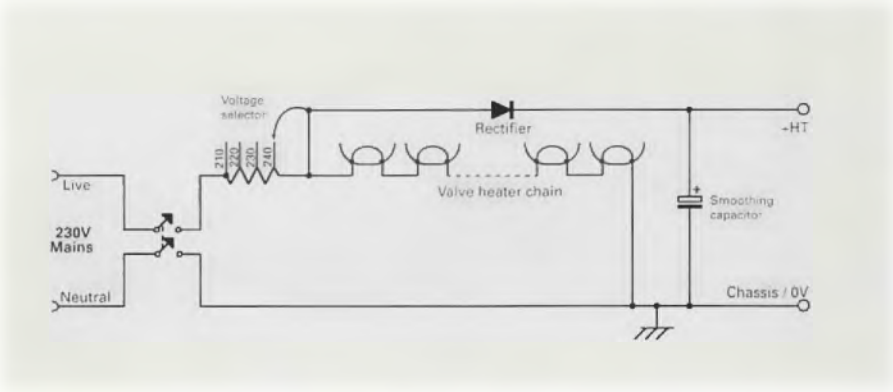

Fig. 3: Typical power supply arrangement for 1950s TV set.

A Step Back in Time.

In the early 1950s, when I started work on my 15th birthday as an apprentice radio and TV engineer, things were not quite as they are now. 'Radio' mainly consisted of the Light, Home and Third programmes, broadcast on long and medium waves, and while portable radios had a built-in loop antenna, most radio users had some kind of wire antenna plus an earth connection.

One day our TV installation technician came back grinning all over his face. After he had fitted the TV, the householder had asked him to have a look at their radio because they were getting a lot of interference. The usual answer to interference in those days was to ensure that the customer had a good antenna and earth connection so he traced the wires. There was about 50ft of wire strung up to the gutter and across to the outside toilet at the bottom of the back yard so that seemed fine but where did the earth wire go to? He traced it along the skirting board as far as some plotted plants and in one of the plant pots was a nice new copper earth rod that they had recently purchased.

I had read a similar story in one of the trade magazines and doubted that it could be true, until this actually happened. Well, to be fair, the instructions with the earth rod had not clarified that the damp earth that it was to be buried in still had to be attached to Mother Earth. How was the customer expected to know?

Even Stranger

A couple came into the shop to buy a TV set. The sales manager ascertained that they had not had a set previously so he arranged for an antenna to be fitted to their cottage, prior to the installation engineer being sent along with the TV. When he arrived a few days later, he asked where they wanted the TV fitted and then looked around for the nearest mains socket. There wasn't one, neither was there any electricity in the house. The couple simply did not know that a mains supply was needed for a TV! They had a gas supply, and this provided heating, operated their gas fridge and the lighting using gas mantles (it's surprising how bright they were) so they assumed that it would operate the TV.

Electricity is something we now take for granted in the UK yet I can still remember being taken to a poultry farm run by my dad's uncle **Charlie** over 70 years ago and being shown that they ran everything from paraffin, even the lights. Electricity was available in the area but he would not have it – he considered it too dangerous! We would now consider that the fire risk they ran from all the paraffin heaters and lamps was very much greater.

It might surprise younger readers to learn that in the 1950s almost all television receivers, and many radios, were intended for use on either AC or DC mains, with power supplies similar to that shown in **Fig. 3**.

At that time a very few areas of the country still had local power stations generating 230V DC. Because mains transformers will not function on a DC supply, catering for these very few areas provided the perfect excuse for TV manufacturers to produce AC/DC sets. Mains transformers that would handle the power consumed by a TV would have been heavy and expensive, whereas using a 'mains dropper', as the resistor R1 was referred to, cost pence and added very little to the weight.

Not having a mains transformer resulted in the chassis of TVs and AC/DC radios being connected directly to the mains supply and they were inherently dangerous. They were supposed to be designed so that the user could not touch any live part and had to be installed so that the neutral mains lead connected to the chassis. All TV engineers carried neon screwdrivers to enable them to check that the chassis was not live before trying to adjust anything because many TVs were wired to a reversible two-pin mains plug!

As I have mentioned before, if you are ever asked to repair any old AC/DC valve radios, it is advisable to refuse. They are potentially lethal. You only need to leave a strand of wire touching something, fit a screw that is slightly too long, replace a plastic-shafted control with a metal one or omit to cover a grub screw with wax, to cause a serious accident. Even if you checked that the plug was wired to a three-pin plug the correct way, so that the chassis was not live, moving the radio to a different room could result in it being plugged into another socket, where the live and neutral wires are reversed, an all too common occurrence.

Modern Health and Safety officers would not be at all happy letting 15-year old boys, work on such equipment in a workshop with flag floors and without an isolated mains supply. While there were a few accidents, there were not as many as you might expect. Perhaps trainees learned to obey orders and be more careful in those days or did only those of us who did, survive to tell the tale? Darwin would have had something to say!

Apropos of which, when **Brenda** and I married in 1965, we had the rather old terraced house we purchased 'professionally rewired', yet when I checked, half of the new 13A sockets were wired in reverse. You certainly must not rely on the on/off switch on a mains socket, unless you are absolutely sure that it is correctly wired in the live lead. To be sure always pull the mains plug out – *PW* doesn't want to lose any readers!

Which brings me, to close, to the reminder I put into this column from time to time. I like to hear about problems with older equipment, particularly pre-1990 Yaesu rigs. Please e-mail me (add some radio related term in the subject heading, to differentiate against spam) or write and enclose a stamped addressed envelope. Remember that electricity is dangerous. If you are not familiar with safety precautions, you must never work on your equipment while it is plugged into the mains (switching off at the wall socket does not necessarily make equipment safe).

73 for now, Harry.

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DX Information

Colin Redwood G6MXL looks at various sources of information useful to radio amateurs chasing DX, focusing on the DX Cluster.

If you like to chase the DX (rare and/or long-distance contacts), then there are plenty of sources of information ranging from magazines such as this one to DXpedition websites and more. However, I think the most useful is the DX Cluster because it is the most up-to-date, offering real-time information over the internet (in days gone by, HF DXers would often share such information over a 2m FM frequency but obviously the range was limited. Later, they adopted AX.25 packet radio, with limited linking on UHF channels. The arrival of the internet changed all that. The DX Cluster is global and instantaneous).

The DX Cluster, as its name suggests, is a network of over 50 servers (nodes) that DXers can connect to. These nodes use Telnet protocol to automatically exchange information (Spots) that have been entered by DXers around the world into one of the DX Cluster nodes. You'll find a list of many of the current nodes at: **www.dxcluster.info/WebDXCluster/webcluster.htm**

So how do you use the DX Cluster? I have chosen to illustrate this by means of one of the popular DX Cluster websites namely DXSummit, which is the 'front-end' of one of the DX Cluster nodes. Since I last covered DX Clusters back in the April 2010 issue of *Practical Wireless*, DXSummit has had a major overall in its look and feel.

www.dxsummit.fi

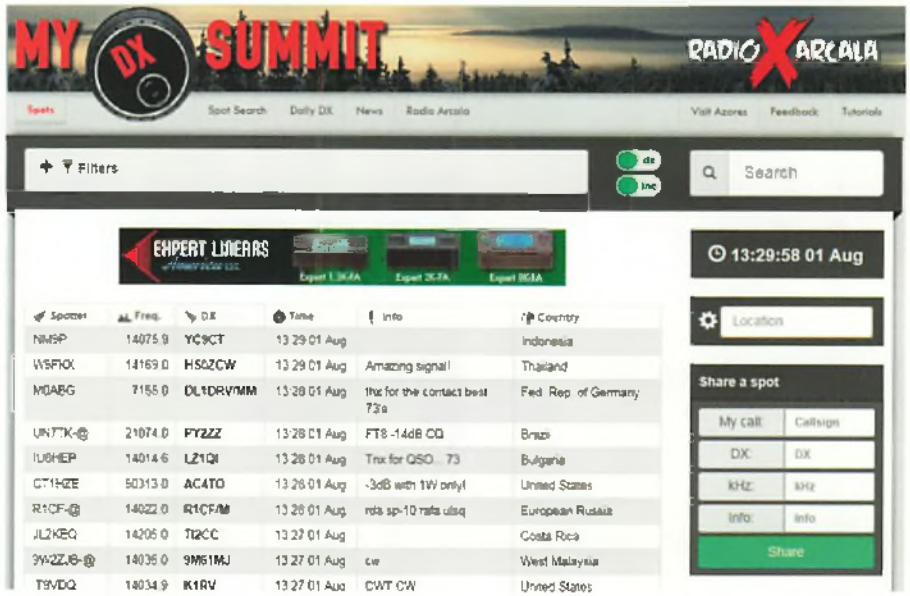

Fig. 1: The DXSummit main screen.

Spots

When you first visit the DXSummit website, it will display the most recent 'spots' for all bands and modes, **Fig. 1**. A spot is where an amateur station has received or had a contact with a 'DX' station of sufficient importance that the station wants to make others stations aware so that they too can try to work the DX station.

The first column on the left-hand side of the screen is the callsign of the station that entered the spot. The next column is the frequency on which the DX station was worked or heard. Note that on the DX cluster the frequency is always shown in kilohertz (not Megahertz), even for microwave frequencies.

The third column is the callsign of the DX station worked or heard by the station in the first column. The fourth column is the date and time in UTC. This is automatically added by the DX Cluster software when it receives a spot.

The fifth column includes any free-format comments entered by the station posting the spot. Typically, this might be locator(s), a Summits on the Air (SOTA) reference or an Islands on the Air (IOTA) reference, frequency split (e.g. Up 5) or the mode (e.g. RTTY, FT8).

Finally, the sixth column is the DXCC entity (country) of the DX station. This is automatically determined by the DX Cluster software based on the callsign of the station in the third column

Filtering Spots

There is a useful facility to filter spots, **Fig. 2**. This enables you to just see the spots that are likely to be of interest to you. You can choose the bands and/or modes you want to see, or exclude bands and modes you aren't interested in. You may occasionally want to change these depending on what bands and modes you are using at any particular time, or during a contest to either focus on the relevant bands and modes in the contest, or perhaps exclude them if you want to avoid spots associated with the contest.

Fig. 2: Filtering options on DXSummit.

The filtering possible with the different

Fig. 3: Filtering options for Continents on DXHeat.

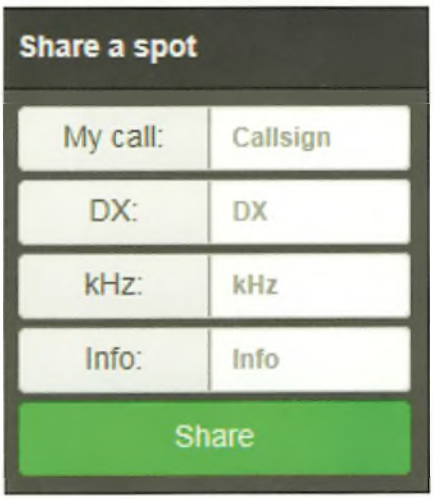

Fig. 4: Entering a spot on DXSummit.

DX Cluster nodes varies. For example, DX-Heat, **Fig. 3**, provides an additional facility to filter on the continent of the spotting station and filter on the continent of the DX station. You may find this useful so that, for example, you just see the spots that have been entered by stations in your continent. DX Heat can be found at: https://dxheat.com/dxc

Using the Information

When a rare DX station is spotted on the DX Cluster, many DX chasers will immediately tune to the frequency and try to work the station in question. If you are lucky, you might work it. If there are many stations calling, you may be unlucky. However, you do know that the band in question is indeed open between the spotting station and the DX station. If you are reasonably close to either the spotting station or the DX station, you can put this information to your advantage because the band is almost certainly open for you, so you could look for other stations in the same area, perhaps by calling CQ.

Announcements

In addition to Spots, some stations also enter announcements. These might be the start of or a late change to a DXpedition, for example.

SP7THR-@	70060.0	SR9RMF	05:51 31 Jul	PI4 -13 dB Q=94 161 km <tr>	Poland
OH7TE	70154.0	OH7RJ	22:11 30 Jul	FT8 -20 dB CQ	Finland
IK4ZIF	71530.0	JH3NGD	20:12 30 Jul		Japan
R4NBB-@	70074.0	4X1GA	19:35 30 Jul	tnx QSO, 73!	Israel
DG1VL	70154.0	ON5CD	17:44 30 Jul	JO20<TR<JO61	Belgium
YO8DOH	70035.8	YR630SV	16:54 30 Jul	CQ CQ ..	Romania

Fig. 5: The station spotting the Japanese on 40m has entered an extra zero in the frequency by mistake giving the appearance that the Japanese station was on 4m!

Fig. 6: The QSLing arrangements for a special event station seen on QRZ.COM

Submitting a Spot

It is very easy to submit a spot. You simply enter your own callsign, the DX station's callsign, the frequency (in kHz) and any appropriate comments, **Fig. 4.** Please don't get carried away with this facility. DXers around the world really aren't interested in your club's local 2m net or that you worked a QRO (high power) Italian station on 20m from the UK! Stick to spots that really are DX on the band in question that you have heard or worked. Some nodes require you to register before you can submit spots.

Be careful when entering callsigns because an incorrect one may result in the wrong DXCC entity being shown. Likewise, take care when entering the frequency. As I said earlier, this is in kilohertz and not Megahertz. Be particularly careful with the number of zeros entered. Errors here, for example, can give rise to a station in the 7MHz (40m) band being shown as spotted in the 70MHz (4m) band., **Fig. 5.**

For VHF and higher spots, entering the relevant locator squares in the comments can be helpful, for example IO90 <> JN37 to indicate that you are in IO90 square and the DX station is in JN37 square. If a station is not using SSB or CW, it is useful to enter the mode (e.g. RTTY, FT8) in the comments. If the DX station is operating using split frequencies (listening a few kHz higher or lower than they are transmitting) then it is helpful to include 'Up 5', for example, to show that they are listening for stations that are transmitting 5kHz higher. Remember, the purpose of the Cluster is to help others work DX, so it really does make sense to provide relevant information that may help them.

What to Spot

For the purposes of the DX Cluster, spots should certainly be something a little out of the ordinary or rare for the band in question. It is unlikely, for example, that working another station in the same country or nearby country would be considered DX on any of the HF bands. If a band such as 6m suddenly opens to another continent, then by all means enter an appropriate spot. However, there is little value in numerous stations spotting the same DX station on the same band. Likewise, once two or three stations in one particular square have been spotted on 6m, what is the point of spotting yet another?

Self-Spotting

If you are operating on a 'rare' band (such as one of the microwave bands), then there is generally no objection to self-spotting – the practice of entering your own callsign as the DX station – to let everyone else know that you are looking for contacts. It would not be considered good etiquette to self-spot on the main HF bands unless you were operating from a particularly rare country or island, for example.

If you participate in contests, please read the rules carefully before using the DX Cluster during the contest. In many cases contest rules prohibit the entering of 'Spots' by entrants for their station (self-spotting). In some contests the use of the DXCluster puts you into a different contest category or is prohibited altogether.

RBN & PSK

It's worth mentioning, for those of you who prefer Morse code or data modes, that the Reverse Beacon Network (RBN, see

the feature in the May 2018 issue of *PW*, for example) automatically accumulates data on stations being copied on Morse – in other words, it isn't necessary for someone to hear the station and 'spot' it (unlike with SSB). This generates a massive amount of data because a station (not just a DX station) only has to call CQ on Morse and it's likely that it will be copied by one or more RBN nodes. Some Cluster nodes incorporate these RBN 'spots' and they can be very useful when, for example, taking part in a Morse contest. However, the sheer volume means that you'll almost certainly need to have some filtering as I described earlier!

www.reversebeacon.net

Similarly, the PSK Reporter network automatically accumulates 'spots' for many varieties of data modes activity around the world:

https://pskreporter.info

QRZ.COM

If you click on any of the callsigns you see on DXSummit and many other Cluster nodes, you'll open up another window with whatever details are held on the qrz.com internet callbook database. You'll see more details if you are logged on to qrz.com:

www.qrz.com

I'd suggest readers check that their details on qrz.com are correct, especially if they have moved house since they were first licensed. In particular, I would recommend checking that your entry reflects your current preferences for QSLing, **Fig. 6**. With a few exceptions, you can provide qrz.com with as little or as much information as you wish.

DXFuncluster

As I indicated earlier, DXSummit is one of a number of DX Cluster servers that provide DX Cluster information. Another popular one is DXFuncluster that requires you to register to get the most from it. It appears to be particularly aimed at Spanish speaking amateurs but can be configured to provide information in English, French or Italian.

With the DXFuncluster, **Fig. 7**, the DXCC entity is only visible by hovering the mouse over the plus '+' sign on of the right. This seems to me to be a drawback for those of us who cannot instantly recall the range of prefixes allocated to each DXCC entity.

DXFuncluster can be found at:

www.dxfuncluster.com

Fig. 7: With DXFuncluster the DXCC entity can only be seen by hovering the mouse over the '+' sign.

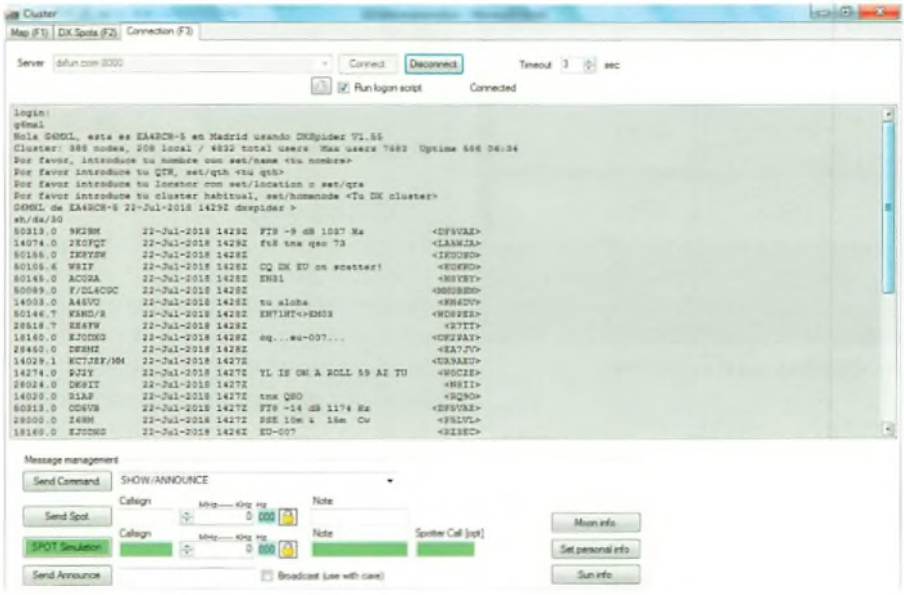

Fig. 8: Details of the integration of a DX Cluster with the popular Log4OM station logging system.

Integration

Some logging software will integrate with the DXCluster. Log4OM is a good example. You'll need to select which DX-Cluster node you wish to use it with. In the screenshots, **Figs. 8** and **9**, I've configured Log4OM to use the DXFuncluster. The VE7CC CC User client software (website below) is highly configurable. It can be used standalone or can sit between the Cluster system and your logging program to ensure you only see spots you are interested in. However, it's probably fair to say this is one for the more serious DXer or contester.

www.bcdxc.org/ve7cc

Hints and Tips

Some countries have different frequency allocations on bands such as 40m. Just because you see a spot on 7220kHz doesn't mean that can work it from the UK, for example, because this is outside the UK 40m amateur allocation. You'll need to be particularly careful if you integrate the Cluster spots with your logging software and transceiver's operating frequency to avoid accidentally transmitting out of band.

DXpeditions

Apart from the almost 'real-time' information available from the DX Cluster, there are a number of websites that provide useful information on upcoming DXpeditions. Several of these have evolved from postal distribution in pre-internet days, so have many years of experience.

425 DX News

425 DX News is a free of charge weekly bulletin edited by **Mauro Pregliasco**

I1JQJ and **Valeria Pregliasco IK1ADH**. It has been produced for many decades and has acquired a reputation as a very reliable source of up-to-date DX news and an input to many other DX listings. If you visit the website, you can see current and historical issues:
www.425dxn.org

DX Schedule

Enrico (Henry) Giannerini, IZ5CML has a useful website that includes a very handy visual schedule of the main DXpeditions for the current month, **Fig. 10**. By clicking on an entry, you'll be linked through to a source with more information:
www.iz5cml.it/dxschedule

Closer to home, the excellent DX World website is run by **Col MM0NDX**:
https://dx-world.net

DXNL/DXMB

The German national society, DARC, publish a weekly newsletter that you can subscribe to. It is available in a choice of English or German. Issues going back to 2010 can be seen online. Before signing up, I suggest having a look at a few issues so that you can decide whether it is likely to be helpful to you:
www.darc.de/der-club/referate/dx/en/dxnl

Les Nouvelles DX

The French *Les Nouvelles DX* website covers many aspects of DXing for those fluent in French. It also includes maps of a number of countries showing the different regional prefixes used:
http://lesnouvellesdx.fr

Fig. 9: Log4OM station log showing the DX Cluster on the right-hand side of the screen.

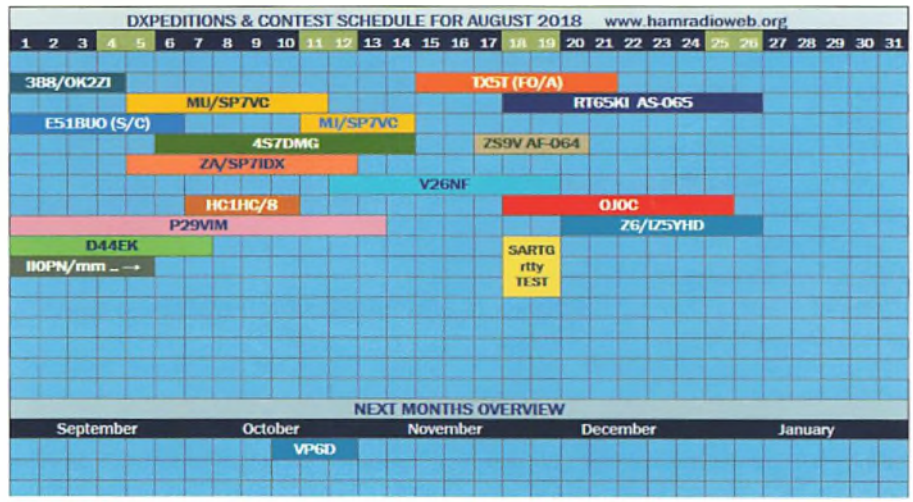

Fig. 10: A summary of the main DXpeditions for August 2018 showing on Enrico Giannerini's website.

• E-mail: roger@g3ldi.co.uk

Bad Morse, Becoming Proficient and More

Roger Cooke G3LDI returns to a previous topic but has a flurry of new correspondence too.

I did suggest that the topic of badly sent Morse (CW) could grow and I suppose we all have our own opinions regarding the subject of CW. I do tend to be free with my own opinions in this column, not to be arrogant, though I guess they could be construed as such, but to promote discussion and in the hope that I might encourage CW operators to improve their skills.

Having been a CW operator and tutor since I was licensed in 1956, I have still not achieved perfection. Being human asserts the imperfections that we all suffer from. I still make mistakes, sometimes getting myself into a real muddle that is difficult to extricate myself from but the attempt at perfection will continue! Being a member of FOC, CW OPS, A1-OPS and FISTS can lead to accusations of elitism but that is not how I see it. We become members of such groups to align ourselves with those of similar interests and abilities.

Gaining Proficiency

In order to become a proficient CW operator, you must dedicate yourself to a large amount of time in order to receive tuition, and above all, do the required amount of practice. The big P-word is the one that cannot be ignored and I am not sure how to convince people of that necessity when they show up for the tuition once a week but don't put in the homework.

All sorts of excuses are forthcoming as to why no practice has been done but I only accuse somebody of being lazy if I know that person and also know that he or she could very well have done the practice but hasn't.

I do try to make allowances for extenuating circumstances and I do make allowances for operators that have medical conditions such as repetitive strain injury or indeed arthritis and Parkinson's. One local had to give up on CW due to Parkinson's and that upset him a lot.

Hopefully all tutors will take this on board and act in a very tactful way when dealing with students in similar situations.

The ones I have less patience with are those normal people who think they don't need tuition because their licence says they can use CW any time they want. I have heard the CW from a few like that and I don't suffer fools gladly!

Anyway, I have had a couple of e-mail exchanges with **Geoffrey Powell M1EDF** on this very subject. Geoffrey is a contributor to and reader of this column and, indeed, the next item is also from him. He thought I was too abrasive in my expectations from students. To reassure Geoffrey somewhat, I would say that my usual students expect a roasting from me when I take a class here in Norfolk! It's a good-cop bad-cop scheme locally, all rather tongue-in-cheek. However, I would not be so presumptive about a new student who I didn't know personally. Nevertheless, I do still adhere to my principle of regular practice.

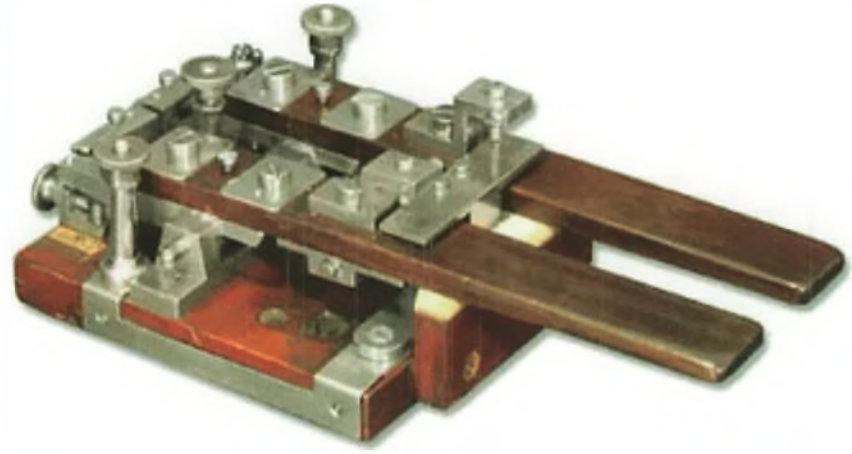

Fig. 1: Double current key as used by M1EDF.

So, no more about bad Morse!

Double Key

Geoffrey trained as a telegraph clerk at Burton on Trent. Featured in **Fig. 1** is the type of double key he was trained on. It worked in much the same way as the telegraph sounders used on the railways.

National Field Day

I had some feedback on my Field Day (NFD) item last time. This was from some of those involved in NFD in that era.

David G4EDR sent me a couple of pictures and says, *"In the 1970s I was a shortwave listener (SWL) member of Scarborough Amateur Radio Society (G4BP) and looked forward every year to helping with setting up the station. We used a homebrew transmitter made by one of the members (G3GKI, I think) and a receiver loaned by another member (G8KU). The aerial would be a simple doublet supported between trees and a scaffold pole. I would watch in amazement the skill of the operators and loggers, hoping one day to get my own 'ticket'. I did and became G4EDR but*

Fig. 2: G4BP being operated by G3JBR.

have never been able to match them. However, as they say, practice makes perfect and I am still working on it!

"I attach a couple of pictures I took. In the first, ***Fig 2****,* ***G3JBR*** *(**Peter Tipper** – Silent Key) is operating and in the second,* ***Fig 3*** *(we took the tent away near the end of the contest),* ***G8KU*** *(**Percy Briscombe** – also SK) is operating, G3JBR logging and my Dad (**Ted Mappin**, later to become **G4FLO** and now SK) is listening in.* ***G3LCG*** *(**Peter Bateman** – SK) is standing at the rear. Happy days!"*

Here in Norfolk we also take the tent away (if it's not raining!) for the last hour or so to help speed up the tear-down. I note also that there is no computer, a bug key was being used and a real paper log, of course. I think in the 1970s we were using my home-made four-memory keyer with a Vibroplex paddle. Not exactly macros but with four programmed memories, I was still accused of cheating, tongue-in-cheek of course.

Gary Bold ZL1AN

I was very sorry to hear that **Gary Bold ZL1AN** had become Silent Key. Gary wrote TEACH4, the Morse program that we use locally for tutoring. It has a very nice note, about 1000 practice files, the ability to use your own files and is easy to use. Gary kindly enabled large and bold fonts to help with read-back and was always very cooperative with any modifications that we asked him to make. Gary was a physicist and one of New Zealand's 'most influential science educators'. He also wrote the Morseman column in New Zealand's *Break-In* magazine.

CW OPS

Several of my local amateurs are now members of the CW OPS club and we have been taking part in the Wednesday activity hours. There are three separate sessions, 1300, 1900 and 0300 the Thursday morning, all UTC times.

I have had some interesting results from these. First of all, I was quite surprised at the speed some of the operators use, 35-40WPM being quite common. Activity is really high during that hour and this is most noticeable during the 0300 session. Listen on the 40m band 15 minutes prior to 0300 and it is just about dead. It's like a switch being turned on at 0300 and some of the US stations are 599 plus, a real report, I hasten to add. Admittedly there are some very weak ones too. I usually end up with around 50-60 in the hour. Normally with search and pounce (S&P) operating I have to queue for a contact because the US stations are hearing each other a lot better than they can copy me but it is interesting. I have worked quite a few on 80m too but the other bands are normally closed here in the UK at that time.

Fig. 3: G4BP near the end of Field Day – see text for details.

These activity sessions are open to non-members too so take a listen and make some QSOs. The exchange is NAME and membership number or, if you are not a member, NAME and country. It's great fun. https://cwops.org

See you next time. 73 and may the Morse be with you. Roger G3LDI.

• E-Mail: practicalwireless@warnersgroup.co.uk

LimeSDR Mini

Mike Richards G4WNC is taking a look at the LimeSDR Mini and 3D printing and showing how you can get away from the noise with an Airspy HF+.

Regular readers will recall I mentioned the LimeSDR development board a couple of months ago. This board offers a multi-channel transceiver with an operational range of 100kHz to 3.8GHz and a bandwidth of up to about 60MHz, all for $299 (~£230). Early buyers rapidly discovered that the HF performance was very poor due to the input matching networks and the board is best used with a decent up-converter for HF use. Lime have published some mods to improve the HF performance and you can request an HF modified board at order time. While this improves the performance, it's still very deaf on HF and the open front-end makes it prone to out-of-band overload so an external up-converter is the best solution for LF-HF operation.

The LimeSDR now has a smaller and cheaper sibling in the form of the LimeSDR-Mini. The LimeSDR-Mini is the size of a large USB dongle, **Fig. 1**, and has a tuning range of 10MHz to 3.5GHz with a maximum bandwidth of 30MHz when using a USB 3. The Mini uses the same Lime transceiver chip as its bigger brother but has a smaller FPGA and a lower sample rate. The LimeSDR-Mini costs $159 plus $10 carriage, which equates to around £131. However, the units are liable for import duty, so you may well get caught for an extra £20 or so in UK taxes. As you can see from the photo, the LimeSDR-Mini uses a very high-density PCB with many components in the 'fairy-dust' category, so it's wise to pop it in a case for protection. The suppliers have produced a very smart aluminium case but the cost is nearly as much as the LimeSDR-Mini at $140 so I skipped rapidly past that option. The alternative, acrylic, case looked suitable but was still way too expensive at $40 (£30)! With the help of Google, I discovered the design files for a 3D printed case that was available for free download under a Creative Commons licence:

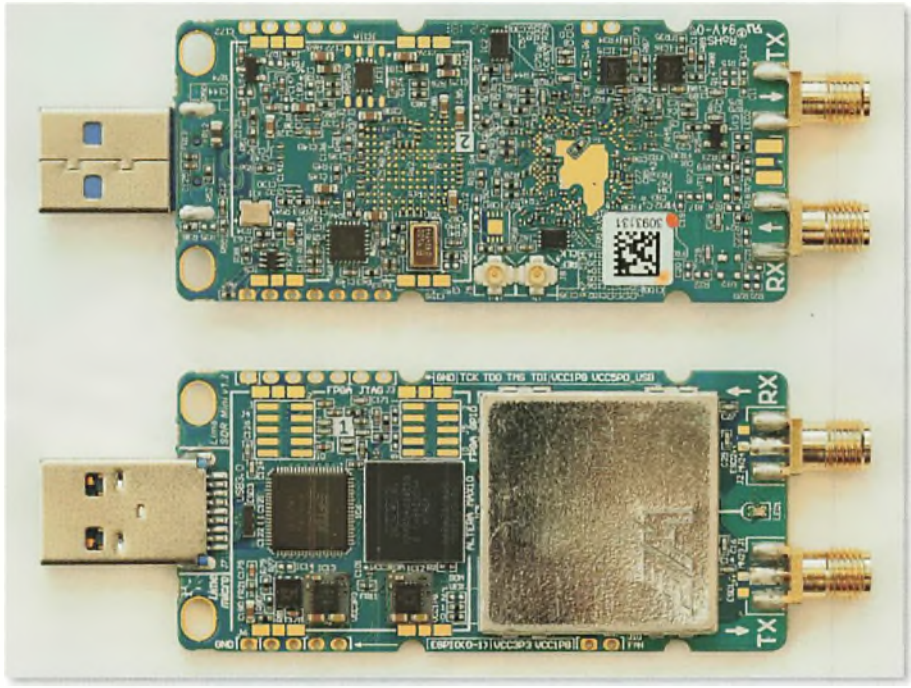

Fig. 1: LimeSDR-Mini – built with fairy-dust!

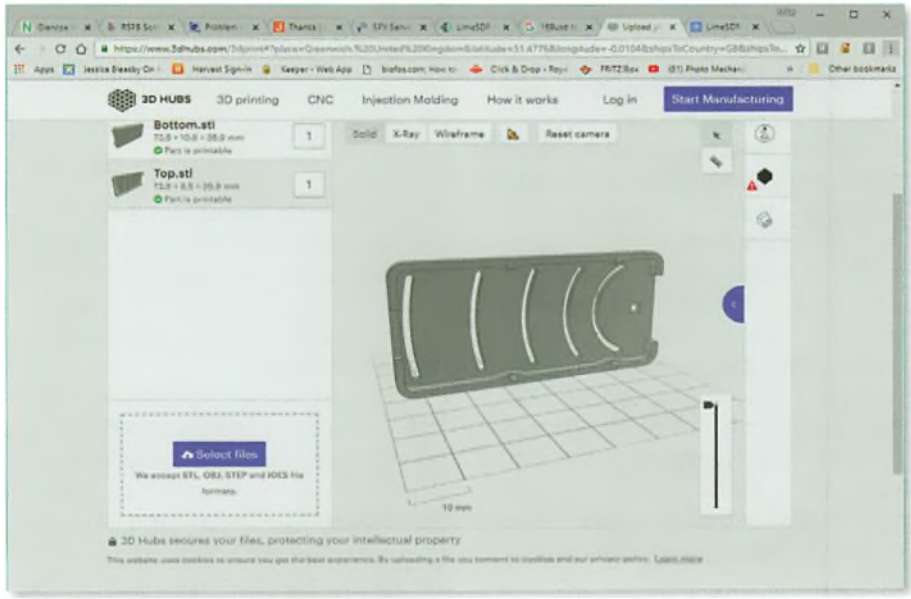

Fig. 2: 3DHubs – preview of the Mini enclosure.

www.thingiverse.com/thing:2816863

Because I haven't managed to persuade **Elaine** to let me buy a 3D printer (yet!), I had to find someone to print the case for me. The answer was to use 3D Hubs (URL below). They operate as an agency selling the services of a large network of individuals and companies with 3D printing facilities.

www.3dhubs.com

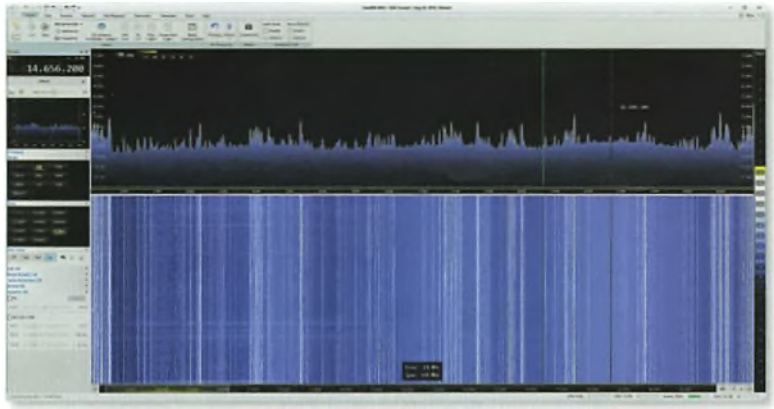

Fig. 4: 20MHz wide spectrum display using LimeSDR-Mini and SV1AFN up-converter.

Fig. 3: LimeSDR-Mini in 3D printed enclosure.

Using 3D Hubs was very easy via their simple web interface. The first task was to upload the design files, which can be any of the common 3D printing formats. I used the .STL files for the Mini case. There were two files in the set, one for the top and the other for the bottom. Once the files had uploaded, the site displayed a scaled 3D view of the design that you could rotate to check that it looked as expected, **Fig. 2**. The next step was to choose the material and I selected ABS because this is a useful general-purpose material. However, it seems PETG would have been a slightly better choice so I've ordered a couple more in that material. With the design parameters complete, the site produced a quote for the work of £10.76 with a five-day delivery, which seemed very reasonable, especially as that was for two units. Once I'd placed the order, I received regular e-mail updates from the printer and the order was delivered a couple of days early. I've shown the finished unit in **Fig. 3.** I had to do a small amount of rework to make room for the PCB to fit but that only took a few minutes. The case lid has four tiny cone-shaped fixings that are a friction fit in the corresponding holes in the base. This was not a particularly good solution because the points were very fragile. The printer had warned me about this before the job was printed, which was helpful.

As you can see, the finished case looks the part and provides good physical protection for the LimeSDR-Mini. Performance-wise, the LimeSDR-Mini is very deaf at its low frequency range but worked well when paired with my SV1AFN upconverter. This upconverter translates the 0-55MHz frequency range up to 200-255MHz and includes good quality filtering to eliminate signals outside the 0-50MHz range. There is also a switchable HF LNA to provide some additional gain but this must be used with care or you will overload the front-end and cause more spurious signals. The SV1AFN upconverter is particularly well suited to the LimeSDR modules and its LF performance is excellent. You can see more details of the upconverter and purchase an assembled PCB for about €40 or a, very smart, boxed unit for €90 via **Makis's** website at:
www.sv1afn.com/upcnv.html

For general amateur radio use, one of the attractive features of the LimeSDRs is their very wide bandwidths. This means you can observe (and record) large chunks of spectrum and I've shown an example of a 2-22MHz spectrum display in **Fig. 4**. This wide view is particularly useful for monitoring activity on the VHF/UHF bands. The wide bandwidth capabilities of the LimeSDR modules also mean that a USB3 connection is essential. The next Lime project for me is to get amateur digital TV running and I hoping to be able to do that using a Raspberry Pi.

Beating the Noise

Unless you live out in the sticks, you are probably struggling with man-made noise compromising the RF noise floor. While the WSJT-X modes are a big help for data modes operators, it can still be a battle. There are opportunities for using noise cancelling techniques with some of today's more advanced SDR transceivers but many of us are stuck with the local conditions. One way forward, that's getting easier to achieve, is remote operation where your rig is located in an RF quiet location and accessed using an internet link. However, that's a pretty drastic and often expensive solution. A more economical alternative could be to mimic commercial practice and employ separate transmit and receive sites, the simplest option being to keep your main rig at home but use a remotely located receiver. One modern receiver that's ideal for this application is the Airspy HF+ SDR, **Fig. 5**. This is a very capable receiver that's enjoying continuous firmware development to fine-tune the performance and the result is an excellent SDR receiver for amateur radio use. Coverage is 9kHz to 31MHz and 60-260MHz, thus covering all the LF/HF bands plus the 4m and 2m VHF bands.

To complement the receiver, Airspy have developed the Spy Server software that can run on many different computer systems, including the Raspberry Pi. One of the problems associated with accessing SDRs over the internet is the poor and variable bandwidths offered by typical internet connections. The bandwidth requirement for an Airspy HF+ sending full IQ samples is around 13Mb/s but this needs to be a sustained data-rate or the receiver will stutter. This moderate data rate is often difficult to sustain, thus making remote SDR receivers a bit more of a challenge. The Airspy team have developed an ingenious solution to the bandwidth problem by moving some of the signal processing from the SDR software to Spy Server. Instead of just passing the raw samples to the network, Spy Server first decimates or under-samples the incoming IQ data to reduce the sample rate to a few tens of kilohertz, just wide enough to contain the selected modulation type. That immediately provides a significant network saving but what about the spectrum display?

The spectrum display is produced by Spy Server software running on the Pi instead of the SDR software on the PC. The resultant video frames are then sent to the host computer. The video frames only need to be sent at around 15-25 frames per second and therefore have a much lower bandwidth requirement. In addition

Fig. 5: Airspy HF+ HF and VHF receiver.

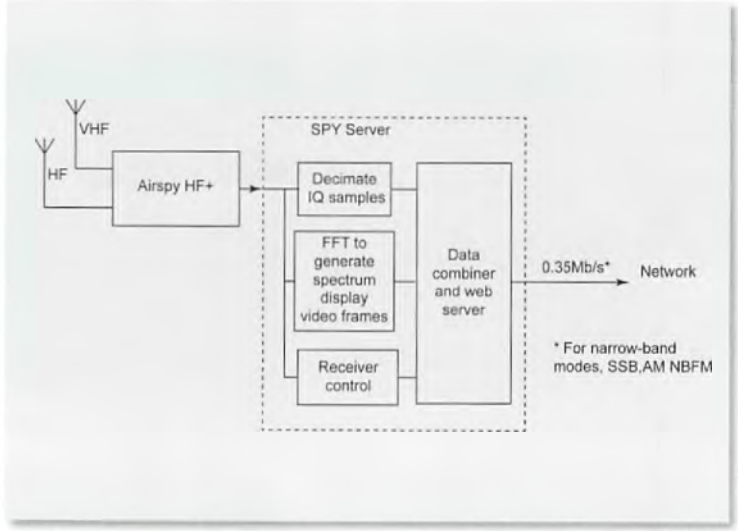

Fig. 6: Spy Server block diagram.

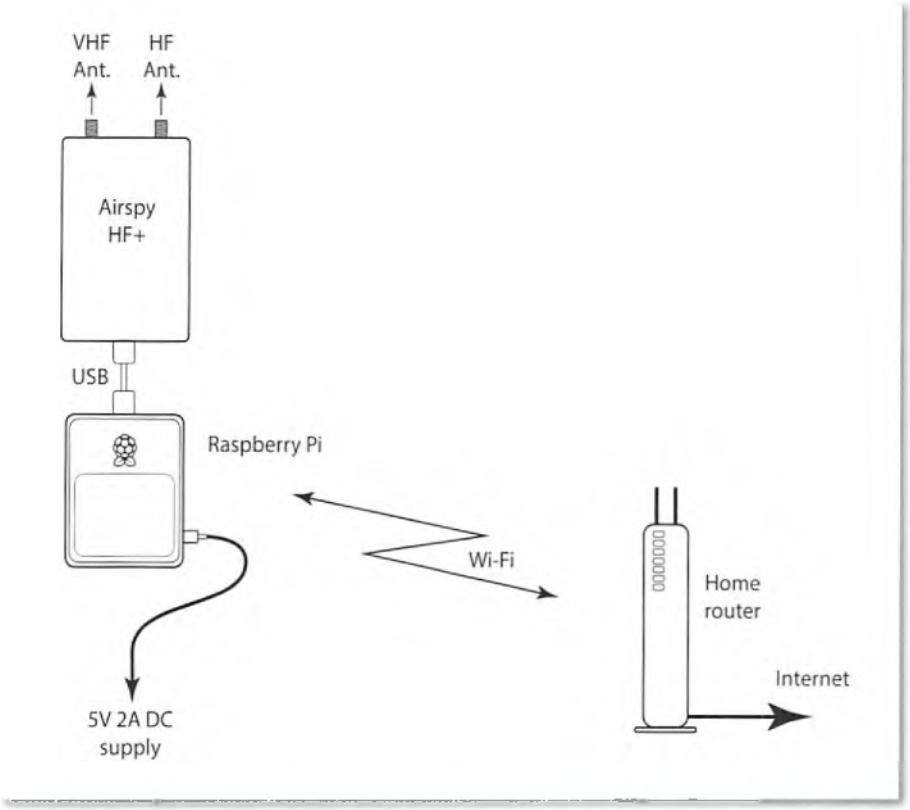

Fig. 7: Diagram of a small footprint Spy Server installation.

to handling the signal processing, the Pi also runs the server that combines the decimated IQ samples, FFT video frames and receiver control signals and makes that combined data stream available to multiple users. I've shown a block diagram of the Spy Server's operation in **Fig. 6**. Spy Server manages to reduce the bandwidth requirement to just 0.35Mb/s for common narrow-band modes such as SSB, AM and NBFM. That's a bandwidth reduction of well over 90% and enough to make Spy Server workable over most internet connections.

When Spy Server is operating with a single connection, the operator has complete control over the receiver and can tune anywhere within the receiver's tuning range. However, if another operator connects, the central tuning point is locked. This is because it's not practical to have more than one operator controlling the main tuning point. However, each connected operator can still tune anywhere in the receiver's bandwidth, which is around 660kHz for the HF+ and plenty wide enough for most amateur bands. By changing a few values in the Spy Server configuration file, the receiver's tuning range can be restricted or locked. There is also the facility to automatically disconnect users after a pre-set period.

The HF+ and Raspberry Pi combination is very compact and only requires a single 5V 2A DC supply because the HF+ takes its power from the Pi's USB port. Because this is such a compact setup, you might find it easier to persuade a friend or relative living in a good location to host your remote receiver. You can even use Wi-Fi for the network connection, thus limiting the cabling to the 5V supply and an antenna, **Fig. 7**! This could also be a project for your radio club. If you could find someone with a good radio location who would be prepared to run Spy Server, the IP address could be shared with club members. In addition to the potential to reduce noise using a remote receiver, the same receiver can be used as a useful signal indicator for checking the quality of your transmissions.

Setting-up the Pi

As I've run out of space here, you can refer to my blog for details of how to load Spy Server on the Pi. I've also shown how to run Spy Server as a Linux service. This is particularly useful for remote operation because the server will automatically restart in the event of a failure and the Pi will automatically reboot after a power failure. For those that don't want to mess with Linux, I have programmed microSD cards available with Spy Server installed along with several useful update scripts. These also include seven pages of printed instructions. You'll find these in my Web shop at:

g4wnc.com/shop

• E-mail: practicalwireless@warnersgroup.co.uk

Rebuilding Time

This month Lee Aldridge G4EJB gets as far as persuading his Howes transceiver to work again.

About time to start investigating the old Howes 20m CW transceiver, Fig. 1, that's what I said. I had been reluctant to look at it for a while. I think the lack of access to proper test equipment was one issue. Secondly, it was about seven years since I'd had the lids off and even though it had been nicely built, I had no idea if it had been switched on, aligned or tested. Could I fix it if it was faulty? That was really a large part of the reluctance. Anyway, with the modicum of success of the previous projects, I decided to have a go.

To cut a long story short, even though all appeared to be fine, certain issues had to be addressed. There was receiver audio instability and hum, the VFO was drifting and generating hum of its own, the buffer board was not helping the cleanliness of the VFO and didn't function, the S-meter board didn't work due a component that hadn't been soldered at one end, a couple of preset pots were a little fragile (meaning that I broke them), the transmitter board didn't function because, again, a component hadn't been soldered at one end. But apart from that, whoever built it was probably rightfully proud of their accomplishment.

I found it best to eliminate one problem at a time. While working with this type and age of technology, I had read through some of the original C M Howes notes on construction and also found a useful article on direct conversion receivers: https://tinyurl.com/y96bxyh7

(The article appears to have originated from *RadCom* and accredited to **Nik Hamilton G4TXG**).

Using the original construction notes, substituting screened audio cable, isolating and screening the VFO board, upgrading frequency critical components in the VFO, adding a few electrolytic capacitors to DC supplies on boards, rebuilding the buffer to feed my frequency counter, improving earthing and adding illumination to the S-meter – that's the bit I excel at – provided me with a working and amazingly stable 20m CW transceiver.

Fig. 1: The author's venerable Howes transceiver.

Testing

I built an RF probe, **Fig. 2**, and learned how to calculate power from the resultant DC voltage reading on my DVM. One useful article I found online was: www.ab4oj.com/test/pwrmeas.html

I then connected up my economy SWR bridge with a dummy load and with my transmitter on a set frequency, I made a pencil mark on the bridge to indicate 2W full-scale reading. Not quite the most accurate measuring equipment but it was as good as I could do.

There were still a few concerns such as the potential for transmitter-generated harmonics so I built a 20m CWAZ lowpass

Fig. 2: The simple homebrew RF probe.

filter courtesy of the designs on the G-QRP club website: www.gqrp.com/technical2.htm

Despite some very cold evenings in my shed, I was delighted with the outcome but still wanted to sort out a few more issues with the radio before I started using it. I thought it required semi-break-in keying and sidetone, while a preamplifier might help liven it up and reduce some of the VFO radiation on receive. Ah yes, a bit more work. I think I was still finding excuses for not getting my Morse back up to speed. At some point it would become apparent that if I was going to make use of my licence with the equipment I had, I would have to address my reluctance.

But for now, I had a working radio in a decent enough case that, yet again, I can listen to while building, wait for it, a Morse key.

Morse Keys

There are times when you wish you hadn't thrown something out even though it was 40 years ago! My old Morse key was with a Wireless Set No.19 and after getting nowhere with the Set No.19, I removed the key from its metal case and mounted it on a piece of wood. Where is it now?

I had looked at some of the very nice Morse keys for sale, looked at the price of second-hand Morse keys, and looked at the very smart iambic keyers and PIC-based keyers. I was still shaking my head. So how am I going to build one? I saw some very innovative keyers detailed in a number of publications but the photo that caught my eye was one by **Peter Howard G4UMB**, I think, using a hacksaw blade. Now there was hope. Little did I know that this was not going to be a five-minute job. Do you think I had a broken hacksaw blade? Well, eventually I did.

Do you think it was straightforward enough to mount the blade in a way that would appear to be feasible to send Morse with? Not the way I built it but, rather than admit defeat, while taking the photo of the key, **Fig. 3**, I took it apart one more time, looked at my construction under the magnifier and made some more refinements. Now it seemed to converse in dots and dashes.

Before my Mark I Morse key had been refined, Morse key Mark II had taken shape using a microswitch mounted in a plastic box. Was this more successful? Well, it saw action first. I'll tell you more another time. Next time I'll share with you some more of the challenges on the way to the first QSO and how I overcame them.

Fig. 3: The Mk1 Morse key.

E-mail: mwimwd@gmx.com

The RWWR Project

Joe Chester MW1MWD is another who has returned to the hobby of late. His tale nicely complements our Starting Over feature.

I saw them coming from way off, fully kitted out, moving at a frightening pace in my direction. I was just hooking up the battery when I heard a loud, slightly out of breath voice say, *"what's going on there then?"* Two joggers flashed past, with wild stares. I do have to admit, we did look a bit odd, with a horizontal pole leaning crazily over the top of the car. Maybe I should start at the beginning.

The Birth of RWWR

You've heard of *Round the World in 80 Days* (**Jules Verne**), and possibly the Round the World yacht race, or maybe *Round Ireland with a Fridge* (**Tony Hawks**). But what about RWWR, then?

We're wanderers, her and I. Boats, planes and trains, we've done it all. Giving up on our barge was a wrench but as we expected when we went sailing 20 years ago (an ocean-going yacht back then), health problems took over our lives in 2015. So, we buy a nice bungalow in South Wales and settle down to avoid as much of the problems of old age as we can. Except it's not quite like that.

I got my amateur radio licence in 1984, in Ireland. Over the years, I kept my interest going but at a low level – the odd contest here and there. Boats don't easily adapt to 20m beams or even VHF ones. As a sedentary existence slowly descended on us in Wales and Netflix addiction loomed, we started struggling to find an escape plan. Radio? Travel? And so was born the Round Wales With a Radio project. I'm sure a native Welsh speaker would find a way to pronounce it – RWWR! Basically, wander around some Welsh tourist spots, put up an antenna and make a few QSOs. Easy. Except it wasn't.

The question arose, mobile or portable? Well, I can't tell you the hours I spent reading about mobile installation and in the end came to the conclusion that most mobile installations, unless the car had major surgery (which madam had strictly

forbidden), were little better than broadcasting into a dummy load. One website stated categorically that the efficiency of even the best mobile station was about 1%. So portable (/P) it had to be.

Equipment Choices

I had an Icom IC-706Mk2G from years ago so all I needed was an antenna and, of course, a fix for the battery issue. The IC-706 is a thirsty beast, with 2A on receive and up to 20A on transmit. A car battery was the obvious choice. Except it wasn't (more on this later).

What about an antenna? Make one, I thought. It's just a length of wire, some coaxial cable and maybe a balun. This approach worked in the attic, where I have both 20m and 40m dipoles. I buy a pole and an under-tyre frame to support it, measure and tie the right length of wire and stick it up in the garden to test it. There were a few quizzical looks over the garden fence from the neighbours but nothing to what came later (read on please!).

The common-mode RF was appalling, with the rig shutting down even on low power. I stuck an ATU on it, an SGC 237 I also had from years ago, and managed a few contacts with difficulties. But it just wasn't working. And then there was the 'footprint'. The stakes in the ground would be a long way from the car (I had difficulty in our postage-stamp garden) and the opportunity for innocent trip-ups was substantial. A 40m dipole was going to be even bigger. I chatted by e-mail with **Richard** at SOTAbeams, who was very helpful. He confirmed my conclusions about footprint but couldn't suggest a solution. The thing I built just wasn't working.

A smaller footprint was the goal, something mounted beside the car, with limited ground coverage. A vertical then. But that involves radials...on the ground – the footprint/trip issue returns. In desperation, I started researching the Buddipole idea. Months went by. As with all things radio there are pros and cons. With Spring now here, it was time to give something a go. I took the plunge and ordered a mini Buddipole (BP). I'll say more about this approach later. Lots of practice in the garden saw the neighbours grinning over the fence again! Then one day, we set off on our first episode of RWWR.

First Outing

First came packing it all into the car, which involved the two of us carting a 50kg car battery through the house and into the car boot. Nice big car park when we arrived, set up the tyre plate, got the 20m BP on top of the fibreglass pole, tied it down with some string as guys and despite the 45° lean over the top of the car, got it all going. The joggers jogged past. Madam went off for a wander and a swim. Made three contacts that day, my first /P contacts, but I wasn't happy. I had common-mode issues and the antenna, at a crazy angle, looked dodgy, to say the least. I headed off for a wee break and when I got back the car was surrounded by a crowd of at least two people. *"My neighbour has a bigger version of that on a gantry in his front garden."*. Well done him, I wanted to say, but decided against.

Reflections

We pack up, and head home. First job?

Carry that damn battery back into the shed! Over the next few days, I spoke with several people about our experiences. The immediate issue was the weight of the BP components when they are 3m up in the air (they seem quite lightweight on the ground). So, it's bite-the-bullet time again and I order that very expensive BP mast. It arrived a couple of days before the June *PW* VHF contest, which I thought was an ideal opportunity to test it out with my Sandpiper 3-element beam. We found a picnic place up the road, at reasonable elevation, and set off. I made 19 contacts in two hours and was very pleased with the result. The mast was very stable, with minimal guying, and we were encouraged to try again with the BP.

Episode 3

After packing up (that battery again), RWWR-3 saw us drive to Rhossili, a lovely National Trust property on the cliffs overlooking the Bristol Channel. Springwatch had been somewhere here earlier. We were directed into the overflow car park, which was nearly empty. We parked as far from other cars as we could (we were not being unsociable but I didn't want to suffer the ire of an owner whose pride and joy had a dent in it from a falling BP).

Setting up was easy. I had bought some stronger guy ropes and made a firm attachment on the BP Versatee for them. Now it was the usual case of put it up, measure SWR, take it down, adjust and put it up again. It took four goes to get it satisfactory. My wife set off on her version of Springwatch. Then connect the battery (I had by now changed the DC connections to Powerpoles, which made the connections easier and safer) and switch on. The IC-706 refused to cooperate. At 10W I got it working but beyond that the rig shut down – common mode again? Or the state of charge of the battery? Checked everything again. Even repeated the tuning routine with the antenna analyser. I heard a few stations but when called, no one answered. Tried calling CQ – no answer. By the way, what I did hear that day was less than edifying, with shouting and name calling on several frequencies.

I decided to change the BP configuration to an L. Then I tried a vertical. By now, exhaustion was setting in (it was 27°C that day). So, after a nice cuppa, we packed up and headed into the traffic. There was an inquest that night.

For the results of that, please tune in next month.

Rallies

Send all your rally info to Georg Wiessalaat: wiessala@hotmail.com

Plan your rally visits with our comprehensive list of forthcoming events. RadioUser will be attending events marked with an asterisk* – come along to our stand for great deals on subscriptions to *Practical Wireless* and *RadioUser*. Club Secretaries and Event Organisers: please send us details of your events if you would like them to be mentioned here.

SEPTEMBER

September 28th and 29th (Friday and Saturday) *

NATIONAL HAMFEST

The National Hamfest will take place at the Newark & Nottinghamshire Showground, Lincoln Road, Winthorpe, Newark, Nottinghamshire NG24 2NY. RadioUser and Practical Wireless will be in attendance. There will be free car parking and disabled facilities, trade stands, a bring-and-buy, a car-boot sale area, flea market, special interest groups and an RSGB bookstall. There will also be representatives from the RSGB services and committees. Morse proficiency test will be available. There will be catering outlets and a seating area.

www.nationalhamfest.org.uk

September 30th (Sunday)

BELGIAN AMATEUR RADIO AND COMPUTER RALLY

This international rally is at LOUVEXPO, rue Michel Debauque/ Arthur Delaby, La Louvière. GPS N50°29'01" / E04°10'51". Direct access from the motorway (50km south of Brussels). The show is open from 9am to 4pm. Talk-in is on local FM repeaters 145.600MHz (and Echolink), DMR 438.875MHz, D-Star 439.4375MHz. This event features 4000m² exhibition space, trade stands from UK, Holland, Germany & France and a flea market. Michel ON7FI

Tel: (0032) 475 45 45 78

michel.dewyngaert@skynet.be

www.on6ll.be

September 30th (Sunday)

PENCOED ARC TABLE TOP SALE

This table top sale will take place at the Pencoed Rugby Football Club, The Verlands, Felindre Road, Pencoed CF35 5PB. Tables cost £10 each, on a first-come-first-served basis. Doors are open from 8am for sellers and from 9.30am for buyers. Admission is £2. Hot and cold drinks available. Hot food available, first thing and at lunchtime. There will be a bar.

Madeline Roberts

Tel: 0773 837 5775.

OCTOBER

October 6th (Saturday)

READING DX MEETING

The Reading International Radio Group will be meeting in Room 3 at Reading International Solidarity Centre (RISC), 35-39 London Street, Reading RG1 4PS. The meeting will take place from 2.30 to 5pm and is an opportunity for those interested in listening to broadcast stations from around the world, on the short wave, medium wave and FM bands, to get together.

Mike Barraclough

Tel: 01462 643899

barraclough.mike@gmail.com

www.bdxc.org.uk/diary.html

October 7th (Sunday)

HACK GREEN BUNKER RALLY

This rally will take place at the Hack Green Secret Nuclear Bunker, French Lane; Hack Green, Nr. Nantwich, Cheshire, CW5 8AL. There will be a sale of electronic equipment, amateur gear, components, military radio items and vehicle spares. Doors are open at 10am, and there will be refreshments available on site.

Contact: Tel: 01270 623 353

coldwar@hackgreen.co.uk

Website: www.hackgreen.co.uk

October 7th (Sunday)

WELSH RADIO RALLY

This is the 45th WRR, and it will take place at Rougemont School, Malpas Road, Newport, South Wales NP20 6QB. Doors are open from 10am, and admittance is £2.50. There will be a bring-and-buy, lectures, an RSGB bookstall, trade stands, special interest groups and a raffle.

Michael Rackham, GW4JKV

Tel: 01495 226 149

rackhamone@aol.com

October 11th to 14th (Thursday to Sunday)

MICROWAVE UPDATE

The 2018 Microwave Update takes place at the Holiday Inn Dayton, Fairborn, Ohio (near Dayton), USA. This is an international meeting, dedicated to microwave equipment design, construction, and operation. It is hosted by The Midwest VHF/UHF Society (MVUS).

www.microwaveupdate.org

October 12th to 14th (Friday to Sunday)

RSGB Convention

The RSGB Convention is at Kent's Hill Park Training and Conference Centre, Swallow House, Timbold Drive, Kent's Hill Park, Milton Keynes, Buckinghamshire MK7 6BZ. The Convention programme of lectures for all interests is available on the website. Principal sponsor: Martin Lynch & Sons.

https://rsgb.org/main/about-us/rsgb-convention

www.hamradio.co.uk

October 14th (Sunday)

HOLSWORTHY RADIO RALLY

The Holsworthy Rally will be held at the Holsworthy Community College, Victoria Hill, Holsworthy, Devon EX22 6JD. There will be traders, a bring-and-buy and catering. The venue also has disabled access. Doors open at 10am.

Howard, M0MYB

holsworthyarc@gmail.com

www.qsl.net/m0omc/holsrally.html

October 14th (Sunday)

HORNSEA AMATEUR RADIO RALLY

The HARC Rally will take place at the Floral Hall, Hornsea HU18 1NQ. Doors are open from 10am; admission is £2 (under 14s go free). There will be trade stands, a bring-and-buy run by the Hornsea ARC, and an RSGB bookstall. Hot and cold food is available in the café.

Les, 2E0LBJ

Tel: 01377 252 393

lbjpinkney@hotmail.co.uk

www.hornseaarc.co.uk

October 27th (Saturday)

ESSEX CW CLUB BOOT CAMP

The Boot Camp is at the 3rd Witham Scout & Guide HQ (at the rear of Spring Lodge Community Centre), Powers Hall End, Witham, Essex, CM8 2HE. Doors are open at 8.30am for registration. The session will run from 9am to 4.30pm. Parking is free, £10 entry, free snacks.

Andy G0IBN

Tel: 0745 342 6087

info@essexcw.org.uk

www.essexcw.org.uk

NOVEMBER

November 17th (Saturday)

RADARS TRADITIONAL RADIO RALLY

The Rochdale & District Amateur Radio Society Rally takes place at St Vincent de Paul's, Caldershaw Road, off Edenfield Road (A680), Norden, Rochdale, OL12 7QR. The doors are open to the public at 10:30am and disabled visitors will gain access 15 minutes earlier. Admission is £2.50, with those under 12 years free. The cost is £5 per pitch (for traders with own tables) or £10 for a pitch, with the table provided. There will be a bring-and-buy, commercial traders and amateur radio sellers. Refreshments are available, including bacon and sausage butties.

Robert Lynch M0NVQ

Tel: 07778113333

m0nvq@outlook.com

November 18th (Sunday)

CATS RADIO & ELECTRONICS BAZAAR

The 41st Coulsdon Amateur Transmitting Society Rally will take place at the Oasis Academy, Homefield Rd, Coulsdon CR5 1ES. There will be free car parking, doors will open at 10am and admission £1.50. There will be trade stands, special interest groups and refreshments.

Andy Briers G0KZT

Tel: 0772 986 6600

bazaar@catsradio.org

https://www.facebook.com/events/437043790050777/

November 18th (Sunday)

PLYMOUTH RADIO RALLY

The Plymouth Rally takes place at Harewood House, Church Rd, Plympton PL7 1NH. Doors are open at 10.30am, and there is a £2 entrance fee. Hot and cold drinks and hot food are available, all for a very good price. There will be a bring-and-buy stall and many other radio-related goodies

David Beck

d.beck123@outlook.com

www.plymouthamateurradioclub.btck.co.uk

November 25th (Sunday)

BARAC RALLY

The Bishop Auckland Radio Amateurs Club (BARAC) 2018 Rally will take place at Spennymoor Leisure Centre, 32 High Street, Spennymoor, County Durham, DL16 6DB. There will be the usual radio, computer and electronics stalls, bring-and-buy tables, catering and bar facilities. Doors are open at 10.30am (10.15am for disabled visitors) Admission is £2, under 14s go free of charge, if accompanied by an adult.

John G4LRG; Tel: 01388 606 396

Brian G7OCK; Tel: 01388 762 678

DECEMBER

December 1st (Saturday)

READING DX MEETING

The Reading International Radio Group will be meeting in Room 3 of the Reading International Solidarity Centre (RISC), 35-39 London Street, Reading RG1 4PS. The meeting will take place from 2.30 to 5pm.

Mike Barraclough

Tel 01462 643899

barraclough.mike@gmail.com

www.bdxc.org.uk/diary.html

Letters

Send your letters to:
Practical Wireless Letters, Warners Group Publications plc
West Street, Bourne, Lincs PE10 9PH
E-mail: practicalwireless@warnersgroup.co.uk

HMS Amethyst & Special Events

Dear Don,

While I have every respect for the war efforts of *HMS Amethyst* and its crew, I am surprised at **Geoffrey Powell M1EDF's** comments (*Letters*, September) concerning the lack of G contacts and stations 'wasting time'. Geoffrey doesn't state which bands he operated and at what times, which may not have been suitable for contacts at those times. Furthermore, amateur radio communication of any kind should not be considered as time wasting. Personally, I feel that in general the real purpose of amateur radio communication has been lost. Special events should serve a purpose other than simply exchanging reports.

Whilst I am in 'moan and groan' mode, may I make the point of some special event stations abusing split operation on relatively narrow bands such as 17m. Split operation should only be used in rare and unusual situations. A good operator should be able to control the undisciplined rabble. So often the rabble call without listening to what the DX station asks for.

Bill ON9CGB G0MEU
Marke, Belgium

Valve & Vintage

Dear Don,

May I correct some mistakes in our American friend's (WN1M) *Valve & Vintage* article in the September issue of *PW*, relating to aircraft radio. Firstly, the SCR522 was actually a copy of the TR1143. A sample of the TR1143 was sent to the USA with a request to produce a similar radio using their component types. The SCR522 was the result. The channel change mechanism of the 522 was almost identical to the TR1143 and the two units were completely interchangeable as far as wiring was concerned. The SCR522 was retrofitted to the Hastings aircraft when they were used on the Berlin Air Lift because the later eight-channel version of the TR1143 didn't cover the higher frequency range needed. The TR1143 only covered 112 to 124MHz while the SCR 522 covered 112 to 150MHz.

The TR1143/SCR522 systems were replaced in RAF aircraft with the all British made TR1934/35/36 series of transceivers. These were later renumbered TR1984/85/86 when the IF strip was modified to prevent interference on the IF by Radio Moscow!

Also, the AN/ARC5 equipment was only used in a subsidiary role. The main radio on the BC17 was the SCR287. This consisted of the well-known BC348 receiver and the BC375 transmitter, which used the familiar 'TU' units in the tuning circuits. Later on, this system was replaced by Collins equipment

Mike Mills G3TEV
Stroud, Gloucestershire

Knots and Ropes

Dear Don,

Thank you for the very interesting article (September 2018) by **Tom Morgan, ZS1AFS/ZT1T** on ropes. As another sailor, and one-time Scout leader, I would suggest a way to remember the sequence for tying the bowline.

Take the end of the rope in your right hand and make a right-over-left loop a foot or two towards your left hand. This is a rabbit's burrow. The end of the rope is the rabbit, which pops out of the burrow, runs round the tree (the standing part of the rope) and pops back down the hole.

One other comment is that the sheet bend is very good when joining a small rope to a larger one. The bigger one is formed into the simple loop, with the smaller one passing through the loop, round once or twice, and then tucked in. Tom certainly knows his knots well – the camel hitch is not very often seen.

Robert Dancy G3JRD
Gillingham, Kent

Blow Holes

Dear Don,

Having read **Lee G4EJB's** article *Building some Basic Test Equipment*, hands-on readers might appreciate a tip to help alleviate the problem of blow holes in soldered joints. The usual cause is moisture being absorbed into the deliquescent PCB substrate during and following PCB manufacture. Consequently, when heat from the iron is applied to 'make the joint', moisture at the hole flashes into steam and takes the easy way out of the board – through the molten solder – resulting in blow holes. The more moisture present in the PCB substrate, the worse the problem and level of rework. This problem can be minimised by placing the PCB(s) into an oven at 80° to 90°C prior to use for a couple of hours (no hotter – you only need to drive out moisture as vapour, not cook the boards), allowing any heated saturated air in the oven to escape periodically. When allowed to cool, place the PCB(s) into a hermetically sealed plastic bag for storage or until needed. This will prevent the board substrate from reabsorbing moisture from the air prior to use. This happens over a matter of weeks and months, not hours. Silica gel sachets will help, if available. This will considerably reduce the probability of blow holes occurring and reworking only a few joints is a lot less onerous task.

For cleaning the joints afterwards, if required, Isopropanol and a stiff bristle brush is recommended. However, as an emergency fall back, any cheap Vodka (not the good stuff – it's expensive) or methylated spirits and an old clean toothbrush will do the job. (At RF frequencies it's surprising how high voltages can track across traces of flux on boards).

Ian Robinson GW1AWH
Cardiff, Wales

Various

Dear Don,

As **Colin Redwood G6MXL** says in his *What Next* column, buying a second-hand AVO meter is both cheap and easy. Unfortunately sourcing a manual is not. But now we have the link below. Scroll to the bottom to find all the free information PDFs you'll likely need for meters similar to that pictured on page 52 of the September *PW*.

tinyurl.com/avomanuals

I also concur with Colin G6MXL that vintage spares may be problematic and expensive to source (same article). However, sometimes a sideways approach to searching eBay pays dividends. I was trying to source ceramic fuses to refurbish an old AVOmeter for a friend. Fortunately, **John** of J H Components Ltd (Tel: 01543 417471) said, *"We've got loads of those at a reasonable price, they're used in microwave ovens"*. I don't usually recommend businesses but John went the extra mile and even sent me an additional fuse for free. Free is a currency we all understand! Quote: *"We will search for obsolete components you may want."* Follow them at:

tinyurl.com/jhcomponents

Please note: The opinions expressed in any letter published in PW are those of the named correspondent whose letter has been published and they don't necessarily reflect the opinions of the editorial staff or Warners Group. **Editor**

Letters

Send your letters to:
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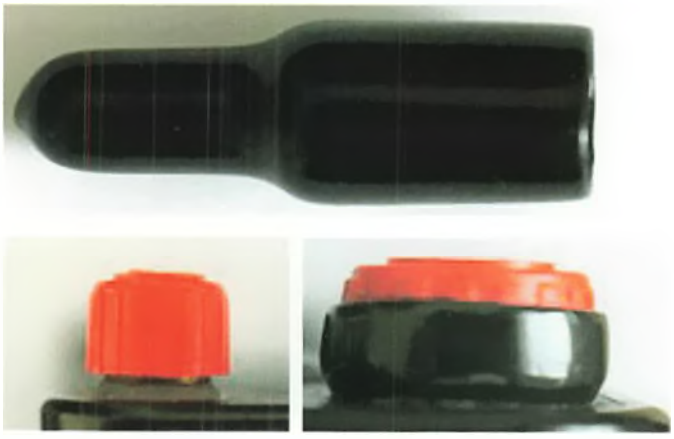
And here's a most useful website that gives service information on vintage AVO multimeters including BLR121 replacement. Quote: *"The AVO meter 8 multimeter has lots of useful ranges, including a special high-resistance range which can measure resistances of up to 20MΩ. This is handy, but it needs a special 15V battery."* **Chris Jones** then goes on to explain how to make a replacement battery as the original type is quickly becoming obsolete.
tinyurl.com/avo8blr121

I recently came across a beat-up old Model 8 MkIII with no leads. Seemingly, you can spend more on a decent set of leads than the meter itself. Fortunately, the AVO has 4mm sockets but modern-day leads have 4mm shrouded connectors. The shrouding insulation can be trimmed back with a craft knife but the holding nut on the bottom of the AVO connector (formerly covered by original lead) is exposed. A Powerpole black boot trimmed back to a tube will slip over (soften the boot in hot water) the AVO terminal and cover the exposed nut, see the photo. That said, I feel that this modification is only suitable for DC up to 50V and AC up to 30V. Leads should be in good condition before making high voltage measurements.

Incidentally, some people are buying up any old AVO (the more distressed the better) then turning it upside down so it looks like a smiling face and installing an industrial type lamp on it. It's called Steam Punk and is most fashionable so if you have a tired old AVO don't throw it away. Give it to Oxfam because they'll soon sell it on. Avolite Stylepunk lights start at £350 to £450. Visit the link below and search: 'avolite'. Quote: *"Optional USB charging port (costs extra)."* See also the second link for some photos. So now a rubbish AVO is worth more than mint? Sigh.
www.etsy.com
tinyurl.com/avosteampunk

On another topic, **Ralph G1BSZ** of Verulam ARC posed the question, *"What can we do to get youngsters involved with amateur radio?"* After considerable thought I don't think we can. But we could introduce junior school age children to the wonder of ELECTRICKERY! A good place to start is the fresh potato/fruit cell. One electrode (negative, zinc) is a clean galvanised nail. The other is copper positive. A bright clean copper penny will work but that's defacing coin of the realm so I use a copper nail or section of spare unused copper PCB. An analogue meter may not read so well as a digital meter. This may be due to the digital meter being powered by a PP3 battery that doesn't load the circuit nearly so much as an analogue meter. An alternative to fresh potato is vinegar or a fresh juicy lemon (yummy, see the link below). Insert the electrodes into the potato close to each other but not touching (around one centimetre apart). Clip leads to connect electrodes to the multimeter. Usually it will read 1 to 1.5V. Connect three in series to light an LED. In 1800 **Alessandro Volta** invented the first battery. Two centuries later a project as above could fire a young child's imagination to greater things. Make/break the connection and you're into Morse code. CQ?
tinyurl.com/lemoncell



Powerpole boot, AVO terminal lower nut exposed & AVO terminal lower nut shrouded

And again with reference to the September issue of *PW*, the Czech Morse key on page 51 sits neatly with the Numbers Stations Cold War articles in a recent issue of sister magazine *RadioUser*. They both have a mysterious, almost ominous, past shrouded in the question *"why?"* Why so many keys, what did the Cold War Czechoslovakian army intend for them I ask myself. Likewise, Numbers Stations are still a puzzle. There are plenty of Czech keys available from eBay, only £40.00 from continental Europe, often Berlin. I have trawled the internet to harvest text and photos as best I can to offer more information on Czech Morse keys via the link below. 90% of the photos include the diminutive key... can you find it? Thank you to all the webmasters who made their information available.

(This only goes to show how important it is to subscribe to *RU* and *PW*! You're really missing out if you don't.)
g4pvb.eu5.net/czechkey.htm
Bob Houlston G4PVB
St Albans

Pye Gear

Dear Don,

I have just read the September edition of *PW* and yet again a diverse range of subjects from news from Australia, your very interesting trip to the Philippines and a drive to Benidorm

£20 STAR LETTER

A Great Time to be a Radio Amateur

Dear Don,
I just wanted to drop you a short note to say thanks to you and your team for consistently producing such an excellent magazine. As someone who returned to amateur radio (in a modest QRP sort-of-way) last year, after nearly 20 years away dealing with the complexities of life, I find the broad range of stimulating subjects covered each month by *PW* to be perfect for someone like me who is relatively unfamiliar with many of the newer facets of the hobby that have been developed since I was last active on the bands.

I was always an avid reader of *PW* during the 1970s, 80s and 90s and can honestly say that the magazine today is even better than I remember it being back then.

Perhaps I should now put my hands up and confess that I was once one of those who firmly believed that the removal of the requirement for Morse code, the introduction of a tiered licensing system and the arrival of the internet were going to kill amateur radio dead. I'm so happy to acknowledge that I was completely wrong.

It's now as though I've suddenly woken up in the future. It has literally never been cheaper or easier to put a signal on the air than it is today. Equipment with capabilities that were unimaginable when I had my first licence can now be bought for the price of a few pints of beer. I find that the hobby is as vibrant and friendly as ever it was. The ongoing integration of amateur radio with IP (internet) is massively interesting and yet another example of innovative radio amateurs being at the forefront of communication technology. Nobody should worry about this, it simply represents another adaptation that will ultimately serve to keep the hobby relevant and interesting going forward.

Thank you once again for the excellent monthly read and do keep up the good work. Now, really is a great time to be a radio amateur and its lovely to be back!
Mark Godden G0ACQ.
Portland, Dorset

Editor's comment: *Thanks for such a positive letter, Mark. I suspect many of us look back at our early days in the hobby and consider them the Golden Years. It was ever thus. But for those entering the hobby now, I feel sure they will look back at this period and say that it was, indeed, vibrant and fascinating. The good thing is, you are finding it so even though you have been active in the hobby previously. Good on you!*

The Star Letter will receive a **voucher worth £20** to spend on items from our **Book Store** or other services offered by ***Practical Wireless***.

along with a variety of technical articles to name a few.

However, what I found particularly interesting was the advert for the auction of part of Silent Key **Dave Hicks G8EPR's** Pye radio collection. Looking at the website he appears to have built up a vast collection of emergency services equipment and I suspect that behind that there could be a good story!
John Sones M0AAO
Ipswich

Editor's comment: *You may well be right Jon, I hadn't really taken that in. But hopefully your interest in Pye gear will be partially assuaged by* ***Bernard Nock G4BXD's*** Valve & Vintage *column in this issue.*

Relay Contact Bounce

Dear Don,
As a retired RF Design Engineer, I often notice minor errors in technical articles but ignore them because I believe that the builder will learn by correcting them when the project is completed but not working as expected.

However, I must highlight a serious problem with *A Simple Paddle Keyer* by **M0CWY** in September's *PW*, which will cause interference to other amateurs if it is used on air. The keyer uses a relay to key the transmitter. All relay contacts have an element of contact bounce. Therefore, if a relay is used to key a transmitter, the RF output will try to follow the bounce and introduce an interfering splatter across several kilohertz of the band. This will happen at all power levels and we all know how far even very low power signals can travel.

The keying relay should be replaced with a MOSFET. This can be switched by any low power device such as a transistor or a PIC with a clean switched CW waveform. Such circuits are readily available on the Internet.
Graham Stannett G4VUX
Croxley Green, Hertfordshire

Dayton Recalled

Dear Don,
Each time I read all about the seemingly boundless ham bounty that is the Dayton Hamvention (report in August *PW*), I'm saddened and happy in equal measure. Simply because my partner and I were once fairly regular visitors. Not possible nowadays, unfortunately, because my partner is on dialysis treatment three times a week. Never got to the Friedrichshafen bash, though, because it coincided with me being stuck behind a stall at stamp shows, flogging stamps and anything else of a philatelic nature.

So, probably like many other wannabe-there radio amateurs, but can't, I'm having to read all about it instead. Having said that, there are YouTube videos of the happenings at Dayton. Not that I watch them, it's all too much to bear. Watching others enjoying themselves while I wish I was there with them is not a pleasant experience for me.

On another topic, I usually enjoy reading all about **Ben Nock G4BXD's** adventures with WWII equipment. I mention this mainly because I often wonder how many British amateurs actually use this stuff. Ben obviously cannot get enough of it. In his August column, he comments on an 'ARB receiver'. As he says, it found a home aboard 'four-engined heavy bombers'. The picture on page 57 looks like a unit that Collins Radio manufactured for the American military. It's a similar shape. Perhaps Ben would enlighten me?

Lastly, in the same issue, I read the review of the Xiegu X5105 QRP transceiver, courtesy of **Carl 2E0HPI**. While I can understand the monetary considerations of buying this rig, I must confess that I still prefer the Elecraft KX2. There again, maybe in a couple of years the Chinese manufacturers of the X5105 will make the decision to buy an Elecraft KX2 almost irrelevant. We'll see.
Ray Howes G4OWY/G6AUW
Weymouth, Dorset

Editor's comment: *Thanks Ray. I don't carry reports of shows and travels to make others envious so I'm sorry if they sometimes have that effect! Instead, it's as you say – you and others can't get to all these shows or go on all these trips so I try to bring them to you, the readers, to keep you up-to-date with what's happening around the world in this truly international hobby of ours.*

Classified Adverts

DISCLAIMER Some of the products offered for sale in advertisements in this magazine may have been obtained from abroad or from unauthorised sources. Practical Wireless advises readers contemplating mail order to enquire whether the products are suitable for use in the UK and have full after-sales back-up available. The publishers of Practical Wireless wish to point out that it is the responsibility of readers to ascertain the legality or otherwise of items offered for sale by advertisers in this magazine.

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MANY MORE BOOKS NEW IN STOCK AT THE PW BOOK STORE ON PAGE 43

Advertisers' Index

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REVIEW: RETEVIS RT3 Tim Kirby G4VXE checks out the Retevis RT3 DMR handheld and we have one as a competition prize.

PW 144MHZ QRP CONTEST RESULTS Colin Redwood G6MXL has the results of the 2018 contest – see how you got on.

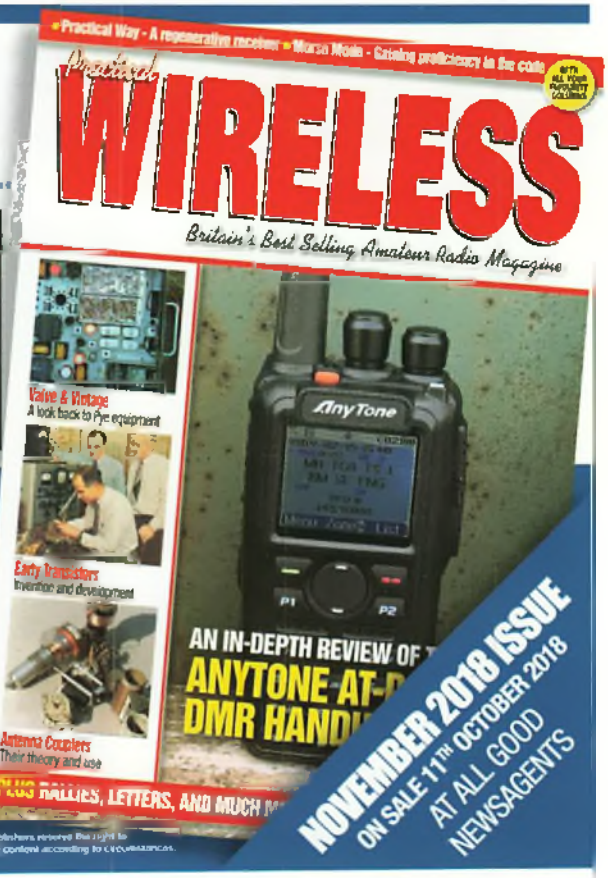
REVIEW – THE FA-VA5 10KHZ TO 600MHZ VECTOR ANTENNA ANALYSER Keith Rawlings G4MIU has been busy with an interesting and useful Vector Antenna Analyser from SDR Kits.

THE TRANSISTOR REVOLUTION (PART 2) Dr Bruce Taylor HB9ANY concludes his look at the history of the transistor.

FREEDV Eric Edwards GW8LJJ looks at a popular route to digital voice on the HF bands.

CHOOSING A MULTIMETER Chris Murphy M0HLS explains the ins and outs of multimeters – which to choose and how to get the best out of them.

Plus our regular columns, including *HF Highlights, World of VHF, Data Modes, Doing it by Design, What Next, Making Waves, COTPW* and *Valve & Vintage*.



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